

ANNUAL REPORT 2024



DIRECTOR'S LETTER



It is my pleasure to deliver the Office of Financial Research's 2024 Annual Report to Congress in accordance with Section 154(d) of the Dodd-Frank Wall Street Reform and Consumer Protection Act. The information covered in this report describes our efforts as of September 30, 2024, the end of the fiscal year.

This was another year of great progress for our Office in support of the Financial Stability Oversight Council and its member agencies. We saw the culmination of several years of work come to fruition during fiscal year 2024, as our staff made significant strides in collecting and providing data to further financial stability research and analysis and enabling collaboration and research among the Financial Stability Oversight Council's member agencies. We continued to invest in our people, processes, and tools to ensure the Office of Financial Research is well-equipped to perform and support valuable financial research.

In an ever-changing environment, we maintain our organizational readiness to serve the Financial Stability Oversight Council and continue to monitor and analyze risks to financial stability, remaining agile to identify and examine emerging threats as they arise.

A handwritten signature in black ink that reads "James D. Martin". The signature is fluid and cursive.

James D. Martin, Acting Director
Office of Financial Research

TABLE OF CONTENTS

DIRECTOR'S LETTER	i
EXECUTIVE SUMMARY	1
THE OFFICE OF FINANCIAL RESEARCH	5
PART ONE: RISKS TO U.S. FINANCIAL STABILITY	7
Framework and Key Findings	8
The OFR's Approach to Assessing Financial Stability Risk	8
Key Findings from the OFR's Risk Assessment	11
1. Asset Markets	14
Equities	14
Treasuries	16
Corporate Bonds, Loans, and Securitizations	18
Real Estate Markets	22
Digital Assets	23
Exchanges and Trading Platforms	25
Securities Lending.....	26
Central Counterparties and Clearing	27
Technology.....	29
2. Businesses and Households	32
Business Borrowing	32
Commercial Real Estate Debt.....	34
Household Borrowing	36
Technology.....	42
3. Financial Institutions	45
Banks	45

Insurance Companies.....	53
Hedge Funds.....	55
Private Lenders.....	57
Mutual Funds and Exchange-Traded Funds.....	57
Lending to Nonbank Financial Institutions.....	58
Technology.....	59
4. Money Markets.....	62
Repurchase Agreements.....	62
Commercial Paper.....	67
Money Market Mutual Funds.....	68
Stablecoins.....	69
Technology.....	70
PART TWO: STATUS OF THE OFFICE OF FINANCIAL RESEARCH.....	73
1. Support the Financial Stability Work of the Council.....	74
Research and Analysis.....	74
Partnerships.....	76
Monitoring Tools.....	76
Data.....	77
2. Achieve Organizational Excellence.....	79
Accountability.....	79
Engagement.....	80
Efficiency.....	81
APPENDIX A: ABBREVIATIONS AND ACRONYMS.....	82
APPENDIX B: GLOSSARY.....	85
APPENDIX C: PUBLICATIONS AND CONFERENCES.....	99
APPENDIX D: ENDNOTES.....	102

EXECUTIVE SUMMARY

This report has two sections. Part 1 provides an analysis of risks to financial stability and key findings from research and analysis. Part 2 details the Office of Financial Research's (OFR or Office) organizational efforts in meeting its mission. This report covers the fiscal year (FY) ending September 30, 2024.

Part 1: Risks to U.S. Financial Stability

As in past years, we identify vulnerabilities in the financial system that could lead to financial instability. Since last year's report, most vulnerabilities are largely unchanged. Some ebb and flow, and some are structural, persisting year after year. A prominent example of the former is credit risk in commercial real estate (CRE) debt. At any one time, most CRE debt is performing relatively well, but one or more components may be distressed and have the potential to stress financial institutions by imposing large credit losses. Today, some office loans have a relatively high risk of default. Another example is vulnerabilities associated with the debt of subprime households, for which delinquency and default rates have risen.

An example of a structural vulnerability is the potential for runs and other rapid changes in the supply and demand for money market instruments such as repurchase agreements (repos). This potential always exists, and widespread runs can disrupt the flow of credit to financial institutions and businesses that obtain a part of their financing from money markets.

Three elements of our financial stability risk assessment are covered differently or to a greater extent than in the past. The first is vulnerabilities associated with the use of technology. For many years, we have written about cybersecurity risk as a topic separate from the traditional vulnerabilities that are the core of our risk assessment. This year, in contrast, technology vulnerabilities are integrated into each chapter in Part 1. Technology is critical to the operation of the financial system. Its pervasiveness amplifies the potential for financial instability flowing from its failure to operate normally, whether the result of a malicious act, such as a cyberattack, an accident, or an error. By integrating technology into the core of our risk assessment, we recognize its criticality for our financial system's functioning.

Second, the design of the Federal government's debt ceiling is a vulnerability. Although the risk remains low, the design makes a failure of the government to meet its obligations more likely. Such a failure might be extremely disruptive to the global financial system.

Third, data gaps are always a focus of ours, and we highlight three of them in this year's report. One concern is uninsured deposits at financial institutions insured by the Federal Deposit Insurance Corporation (FDIC). Data on uninsured deposits are collected for less than 25% of banks, and important characteristics about those deposits are not collected at all. This data gap makes

anticipating and reacting to bank runs more difficult. Another data gap concerns the activities of some nonbank financial institutions. Private credit is a rapidly growing portion of nonbank lending. A substantial fraction of credit extended appears to be high risk, the performance of which is difficult to assess because limited data are collected from these nonbank lenders. Finally, visibility into dealer margining practices remains limited. Margin debt is a form of secured lending. It has features that can cause large movements in asset prices and transmit stress across markets. The OFR's collection of data on non-centrally cleared bilateral repo (NCCBR), expected to begin this year, will include information about margining practices and thus support progress in closing this gap.

Part 2: Status of the Office of Financial Research

The Office engages with and serves the Financial Stability Oversight Council (Council) and its member agencies by providing research and analysis to help identify threats to financial stability, fulfilling Council requests for research and analysis, and working with Council member agencies on research and data projects related to financial stability. This year's report focuses on our successes toward meeting our two FY 2020-24 strategic goals: 1) supporting the financial stability work of the Council and 2) achieving organizational excellence.

In pursuit of goal 1, we advanced insights into financial stability through our long-term research and short-term analysis; our risk measurement and monitoring tools; our provision and collection of data; and our engagements related to data standards.

We disseminated our research and analysis through publications, reports, and numerous speaking engagements. We encouraged research relevant to our and the Council's missions by hosting conferences showcasing state-of-the-art financial stability research. Monitoring tool enhancements included the release of our new Hedge Fund Monitor (HFM) and updates to the Short-Term Funding Monitor (STFM), Bank Systemic Risk Monitor (BSRM), and Money Market Fund Monitor (MMFM). We also enhanced the Joint Analysis Data Environment (JADE), onboarded more users across Council member agencies, and made additional datasets available in support of Council-approved research projects. We amplified our research and analytic capabilities by developing and leveraging collaborative partnerships externally.

Notably, we published the Final Rule on NCCBR Transactions, the culmination of a two-year initiative. We continued to engage in many data standards working groups, including the Regulatory Oversight Committee (ROC), International Organization for Standardization (ISO), Accredited Standards Committee X9 Inc. (X9), and Financial Data Transparency Act (FDTA) interagency implementation working group.

In pursuit of goal 2, we continued maturing the organization while sustaining our focus on the OFR workforce. We executed on opportunities that strengthened our acquisition strategy, team capability, technology infrastructure, and planning for the future—improving our ability to serve the Council and its member agencies and support our team.

We expanded our procurement supplier base and significantly exceeded Department of the Treasury goals for the percentage of contracts awarded to small businesses. We grew as an

organization, hiring critical skillsets and expertise needed to sustain services and advance our mandates. We also implemented a comprehensive training program to support our workforce growth and development and enhanced our hybrid working environment by modernizing office and virtual collaboration capabilities.

As the financial stability and data analytics landscapes evolved and increased in complexity, we made technological enhancements to our cloud environment and cybersecurity capabilities. These enhancements, alongside an independent assessment of our cybersecurity and Zero Trust maturity, enabled us to meet an increased demand for advanced analytic systems that support complex data analysis and visualizations. Our organizational growth in recent years and throughout FY 2024 allowed us to continue to sustain and advance these powerful tools.

Our FY 2024 achievements reflect the culmination of many years of steadfast determination and applied expertise. These achievements demonstrate our ability to deliver meaningful results toward promoting financial stability through high-quality financial data, standards, and analysis. At the close of FY 2024, the OFR published its Strategic Plan 2025-26 that builds on these contributions and provides a roadmap for how the OFR will advance its vision of a transparent, accountable, and resilient financial system.

THE OFFICE OF FINANCIAL RESEARCH

The OFR was established by the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) and is charged with support to the Council in its primary purposes of:

- Identifying risks to the financial stability of the United States that could arise from the material financial distress or failure, or ongoing activities, of large, interconnected bank holding companies or nonbank financial companies or that could arise outside the financial services marketplace.
- Promoting market discipline by eliminating expectations on the part of shareholders, creditors, and counterparties of such companies that the U.S. government will shield them from losses in the event of failure.
- Responding to emerging threats to the stability of the U.S. financial system.

The OFR's duties in support of the Council include:

- collecting and providing data to the Council and member agencies;
- standardizing the types and formats of data reported and collected;
- performing applied research and essential long-term research;
- developing tools for risk measurement and monitoring;
- making the results of the activities of the Office available to financial regulatory agencies; and
- assisting member agencies in determining the type and formats of data authorized by the Dodd-Frank Act to be collected by member agencies.

Pursuant to the Dodd-Frank Act, the Council consists of ten voting members and five nonvoting members and brings together the expertise of federal financial regulators, state regulators, and an insurance expert appointed by the President.

The voting members include:

- the Secretary of the Treasury, who serves as the Chairperson of the Council;
- the Chair of the Board of Governors of the Federal Reserve System;
- the Comptroller of the Currency;
- the Director of the Consumer Financial Protection Bureau;
- the Chair of the Securities and Exchange Commission;
- the Chairman of the Federal Deposit Insurance Corporation;
- the Chairman of the Commodity Futures Trading Commission;

- the Director of the Federal Housing Finance Agency;
- the Chairman of the National Credit Union Administration; and
- an independent member having insurance expertise who is appointed by the President.

The nonvoting members, who serve in an advisory capacity, include:

- the Director of the Office of Financial Research;
- the Director of the Federal Insurance Office;
- a state insurance commissioner designated by the state insurance commissioners;
- a state banking supervisor designated by the state banking supervisors; and
- a state securities commissioner (or officer performing like functions) designated by the state securities commissioners.

Statutory Requirements for the Annual Report

Section 154(d) of the Dodd-Frank Act requires the OFR to submit a report to Congress.

Subparagraph (1) requires no later than 120 days after the end of the fiscal year, the Office will submit a report to Congress.

Subparagraph (2) requires each report to assess the state of the U.S. financial system, including:

- (a) an analysis of any threats to the financial stability of the United States;
- (b) the status of the efforts of the Office in meeting the mission;
- (c) key findings from the research and analysis of the financial system by the Office.

PART ONE:

RISKS TO U.S.
FINANCIAL STABILITY



Framework and Key Findings

The OFR 2024 Annual Report assesses the risks to financial stability in the United States. As in past years, it considers how risks can propagate from one financial institution to many; from one market to others; between markets and institutions; and among businesses, households, and the financial sector. This chapter describes the approach used to assess financial stability risks and reviews key findings from that assessment.

The OFR’s Approach to Assessing Financial Stability Risk

“Financial stability” means that the financial system is able to provide its critical functions to the economy even under stress. That is, it is resilient to the inevitable disruptions.

In assessing risks to financial stability, the OFR distinguishes between vulnerabilities and shocks. Vulnerabilities are weaknesses in the financial system that make it more susceptible to adverse events that can impair financial stability. An example of a vulnerability is a large number of firms with high leverage. Lenders are more likely to experience large losses on credit extended to those firms. Those losses can reduce the provision of credit, as well as other financial services. Some vulnerabilities only become apparent after financial stability has been impaired.

Shocks are adverse events that can disrupt the functioning of vulnerable parts of the financial system. Financial stability can be impaired if a big enough shock hits an especially vulnerable part of the financial system. The set of possible shocks is large and varied. Many shocks are unimaginable before they arise—the unknown unknowns.

The OFR’s monitoring of financial stability is driven by the principle that financial activities and vulnerabilities are constantly shifting. Existing, well-understood vulnerabilities can emerge in new ways. The 2023 bank runs illustrate how the widespread adoption of social media and of technology that supports more rapid withdrawals has altered run risk. New vulnerabilities can emerge gradually; the rise of decentralized finance (DeFi) and crypto assets is an example. Sometimes technology or its adoption changes suddenly, as happened with generative artificial intelligence (AI), which may pose new risks.

Because the financial system is always changing, the OFR must keep asking and answering the following questions: What might impair the financial system’s ability to perform its critical functions? Where are risks accumulating? What are the forces driving changes in risk, and what is the interplay among them?

This year’s assessment of financial stability is organized into four chapters, one for each major component of the financial system. The analysis focuses on the vulnerabilities that can impair the functioning of each component.

- **Asset markets** enable trading and price discovery. They bring buyers and sellers together to determine a mutually acceptable price at which to transact. Asset prices are vital for all aspects of the financial system. For example, asset prices are used to value entities’ financial resources, such as their capital and liquidity. They also value the collateral that secures debt. Trading itself

is critical. It allows market participants to reallocate portfolios and shift risk to those better able to bear it.

Vulnerabilities in asset markets make those markets susceptible to an impairment of trading or price discovery, increasing the risk of sudden price corrections. Market prices change for many reasons. While price fluctuations do not directly disrupt financial stability, they can interact with and reinforce other vulnerabilities to amplify and transmit stress through the financial system. If collateral loses value, for example, then market participants may have to post additional collateral. If they lack the ability to do so, they may try to liquidate assets, resulting in asset fire sales. Many financial stability vulnerabilities associated with asset markets are most salient when valuations and investor sentiment are at extremes or when leverage is high.

- **Businesses and households** are the end users of the financial system. Their production and spending fuel economic activity. Their savings provide resources that support economic growth. The provision of credit allows businesses and households to spend beyond their current resources. It also exposes lenders to the risk of default, especially when borrowers have high leverage and debt service burdens. Unexpectedly high default rates can stress financial institutions and markets to the point at which their ability to provide financial services is impaired. If credit availability to businesses and households tightens as a result, business and household spending could be further constrained, creating additional stress to the economy and financial system.

- **Financial institutions** provide a broad array of financial services. Examples include allocating credit to borrowers, facilitating trading through market making, and providing insurance. Some accept funds that can be withdrawn on short notice and invest the funds in longer-term assets.

Financial institutions become insolvent—unable to meet their financial obligations—when their liabilities exceed their assets. For example, their insolvency is more likely when they rely heavily on leverage, experience large loan portfolio losses, or are adversely affected by sharp drops in asset prices. Even if not insolvent, financial institutions can become stressed if outflows of liabilities become large and rapid. Financial institutions are interconnected with each other and the financial system, so the failure of one or more could have far-reaching effects.

- **Money markets** facilitate payments and provide short-term funding to financial institutions and businesses. They also provide savers and investors access to very short-term instruments with money-like features. Some money market instruments involve the risk of default or of limitations on the ability to quickly convert assets to cash. A sudden loss of confidence can lead to runs, asset fire sales, and the withdrawal of lenders from markets. Borrowers reliant on short-term funding would have to quickly find other sources of financing or risk defaulting on obligations. The ability to make payments could also be disrupted. Because money markets are essential to the functioning of the financial system, stress in those markets can rapidly spread across the system.

In addition, the OFR has long recognized vulnerabilities from the use of technology, including the risk of cyberattacks. However, technology is now even more critical to each major component of the financial sector. Its role is as important as that of any financial market or financial institution.

Its pervasiveness amplifies the potential for nation-state exploitation of technology vulnerabilities to threaten both national security and financial stability. As a step toward recognizing this growing importance, each chapter includes a section about the state of technology vulnerabilities. The limited data available on technology vulnerabilities means that most are not recognized until a disruptive shock has occurred. Consequently, the assessment in this report draws heavily on those episodes.

Three additional vulnerabilities—opaqueness, complexity, and interconnectedness—cut across all other vulnerabilities. Opaqueness arises from data and information gaps that limit the assessment of vulnerabilities. Without visibility into the risks that exist, too much risk may be taken. Complexity refers to the fact that elements of the structure, design, and governance of financial institutions and contracts can make risks difficult to understand. With a more complex financial system, data collected on financial markets, institutions, positions, and transactions shed less light on financial stability risk. Interconnectedness can exist with or without complexity. Elements of the U.S. financial system are interconnected in many ways (see **Types of Interconnectedness**). This means that, among other things, instability-induced constraints on the financial system’s provision of one critical function can easily spread to disrupt the provision of other functions.

As a result, the risks identified in any one chapter can be amplified and transmitted by risks covered in other chapters. Interconnectedness, opaqueness, and complexity appear as themes throughout.

Types of Interconnectedness

Throughout this report, vulnerabilities will often be mentioned as arising from or amplified by interconnections that exist. The interconnections will largely be similar to one of the following simplified examples.

Linked Exposures

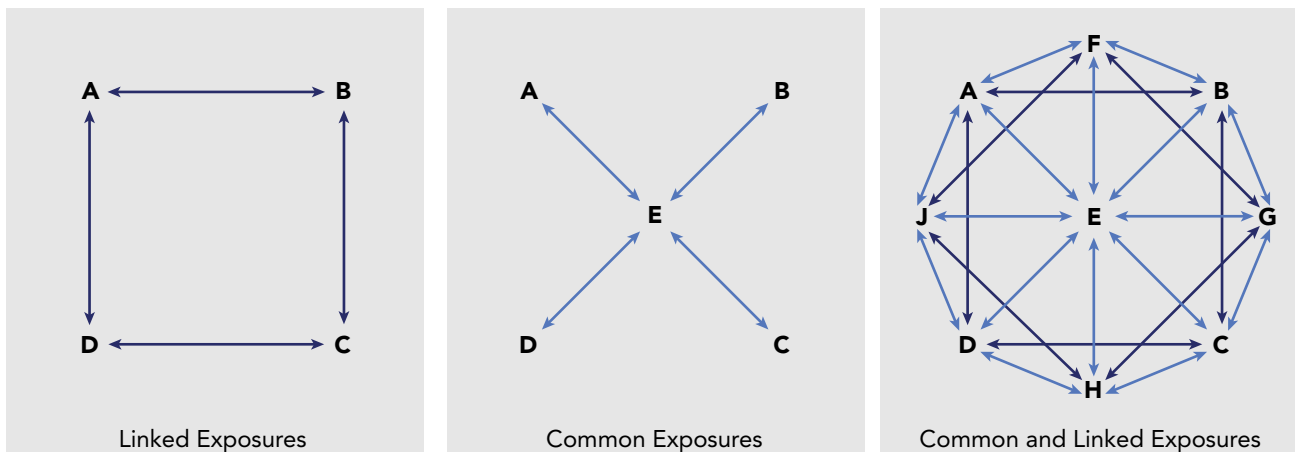
Interconnectedness begins with direct links. These links may form what can be thought of as a chain: A is linked to B and D, while B and D are linked to C, so A and C as well as B and D are indirectly linked but may not recognize the connection (**Figure A, left**). The financial system is replete with interconnected linkages that create complexity and opaqueness. The breaking of a link could trigger a chain reaction in which other links break. Achieving resilience to this risk is difficult without visibility into the existing linkages.

Linked financial exposures exist, for example, when swap dealers intermediate transactions among their clients or offset them with other dealers. Supply chains are another example. Information is an essential input in the financial system and can be a link in a financial supply chain, such as the price information that financial exchanges produce. This price information can feed into investors’ portfolio evaluations and the margin requirements for outstanding derivative positions.

Common Exposures

Interconnectedness can also arise when entities have a common dependency. Examples include entities holding the same asset, trading on the same exchange, using the same service provider,

Figure A. Common and Linked Exposures



Source: Office of Financial Research

or relying on the same source of information about asset prices. Without making any effort to coordinate their actions, entities can end up with a common exposure. Stress involving that exposure could be felt by any connected entity.

Sometimes, by design, common dependencies reduce complexity. Financial market utilities (FMUs) like central counterparties (CCPs), exchanges, custodian or settlement banks, and payment processors are examples. The FMUs replace complex, interconnected linkages and serve as a common point of contact for entities engaging in certain financial sector activities. At the same time, some of the risks associated with FMUs' activities are concentrated in the FMUs. This positions the FMUs to be single points of failure for the financial system. Distress at an FMU could spread to those connected to it and potentially destabilize the financial system (**Figure A, middle**).

Combined Linked and Common Exposures

The financial system is a complex mix of both linked and common exposures (**Figure A, right**). For example, financial markets cannot fulfill their function of pricing assets and enabling trading without the participation of financial institutions and individual investors. Financial institutions need financial markets to perform their function of maturity transformation and credit provision. Businesses and households cannot engage in the activities necessary for economic growth without well-functioning financial markets and institutions.

Key Findings from the OFR's Risk Assessment

Since the OFR's 2023 Annual Report, risks to U.S. financial stability are largely unchanged, and key data gaps remain.¹ In some key asset markets, valuations and investor sentiment remain near extremes or the use of complex leveraged trading strategies has grown. Valuations in residential real estate markets remain stretched, while prices of commercial office properties are falling. Among nonfinancial businesses and households, most are able to service their debt, and vulnerabilities remain moderate. However, delinquency and default rates have risen for the debt

of the less creditworthy of these borrowers. Solvency risk within the financial sector appears low overall, but smaller banks that are heavily exposed to the office property sector face a greater risk of insolvency. Leverage and other financial risks at some nonbank financial institutions (NBFIs) increased. Money markets continue to face run risk due to structural features. Technology disruptions since the last report did not impair financial stability but revealed vulnerabilities that heighten the risk. Data gaps continue to limit visibility into potential vulnerabilities across parts of the financial sector.

The following summarizes the current assessment of vulnerabilities within each major component of the financial system:

- **Asset market vulnerabilities remain elevated.** Equity valuations and investor sentiment are high relative to historical averages, which raises the risk of large, sudden price declines. Corporate bond spreads and other measures continue to suggest that investors expect low default rates on corporate debt, beliefs that may be overly optimistic. In residential real estate markets, price appreciation has moderated from a year ago, although valuations remain high. CRE prices are weak in the office sector.

Exposures to some complex and opaque trading strategies are high overall. The use of leveraged trading strategies like the basis trade remains extensive. Issuance of some complex securitizations has risen. However, securities lending utilization rates continue to trend down.

Other asset market vulnerabilities are more structural and remain notable. In Treasury markets, the type of debt ceiling used in the United States remains a major vulnerability. It makes the risk the government will fail to meet all its obligations, although low, more likely. Off-exchange trading in equities remains substantial. This may increase market fragility because some market makers are not obligated to make markets off-exchange. CCPs remain vulnerable to the failure of clearing members. A key technology vulnerability across markets is the growing role of automated trading systems, which can heighten volatility and increase the likelihood of flash crashes. Structural features associated with the production of some digital assets create run-like risk for those assets. The interconnectedness of these digital assets with the traditional financial system is an emerging vulnerability.

- **Vulnerabilities associated with credit to businesses and households remain moderate.** The default rates on the debt of less creditworthy businesses have been rising, although they are still below the levels reached during the COVID-19 pandemic. The performance of CRE loans has deteriorated, especially for loans on office properties. Some of those loans have a relatively high risk of default. Service outages at technology providers in 2024 disrupted entire industries' operations and revenue flows and revealed striking technology vulnerabilities.

Most households are able to make their debt payments, and vulnerabilities remain moderate overall in the household sector. Still, subprime borrowers' debt balances have grown rapidly, and delinquency rates on their debt are rising.

- **Vulnerabilities at some nonbank financial institutions are growing and can amplify risk at other financial institutions.** Overall, vulnerabilities within the banking sector appear low.

Banks' loan books appear healthy. Even so, some smaller banks with a high exposure to office loans have a greater risk of failing during the next few years. Bank lending to NBFIs remains sizable. Banks may face heightened credit risk on these loans because some NBFIs specialize in high-risk strategies. Stress at banks from losses on these loans can propagate to the broader financial system. Gaps in data on uninsured deposits make assessing bank run risk more difficult.

For some types of NBFIs, vulnerabilities have been rising. At life insurers, leverage has remained fairly stable, while the credit and liquidity risk associated with their assets has grown. Hedge funds' leverage has continued to trend up, and their borrowing has risen sharply. Much of the additional debt is from prime brokers and through repos, which increases complexity and interconnectedness within the financial system.

At other NBFIs, vulnerabilities are largely unchanged or more opaque. Some open-end bond mutual funds that are heavily invested in less liquid assets remain vulnerable due to their structure, which allows large withdrawals by their investors. New types of private lenders, particularly those associated with private equity funds, have grown rapidly. Assessing their vulnerabilities is limited by data gaps regarding their leverage and portfolio exposures.

A series of cyberattacks on financial institutions and their technology service providers (TSPs) in the last couple of years disrupted operations at these and other entities. These events illustrate the potential for technology vulnerabilities to impair financial stability.

- **Vulnerabilities associated with money markets are moderate.** Maturity and liquidity risks are largely structural and expose money market institutions and instruments to significant run risk. In addition, financial institutions, especially those with high leverage, are exposed to stress from their connected activities in money markets in general and repo markets in particular. Gaps in data on dealer margining practices, as in some segments of repo markets, can hinder monitoring the associated risks. Some stablecoins are inherently more susceptible to runs. Their opaqueness makes their vulnerabilities challenging to assess. Technology vulnerabilities at FMUs and TSPs that are critical to money markets expose payments and the broader financial system to the risk of destabilizing service outages.

1. Asset Markets

Asset markets enable trading and price discovery. A breakdown in trading interferes with market participants' ability to rebalance their portfolios, as well as to originate and refinance financial assets. It also impairs price discovery, which is the process of valuing an asset through trading between buyers and sellers. Without effective price discovery, market participants are less able to value entities' capital and liquidity, debt owed, or exposures to the obligations of others, which makes risk management more difficult.

Currently, asset market vulnerabilities remain elevated. Equity valuations and investor sentiment are high relative to historical averages, raising the risk of large, sudden price declines. In Treasury markets, the design of the U.S. debt ceiling is a major vulnerability. Exposures to some complex and opaque trading strategies are high. The use of leveraged trading strategies like the basis trade remains extensive. Corporate bond spreads and other measures continue to suggest that investors expect low default rates on corporate debt, beliefs that may be overly optimistic. Issuance of some types of complex securitizations has risen. Price appreciation in residential real estate markets has moderated from the high rates seen during 2020-22, although valuations remain high. CRE price trends remain relatively weak, especially for the office sector. Off-exchange trading in equities remains substantial; market functioning may be more vulnerable to price impacts from fire sales as a result. Securities lending utilization rates continue to trend down. CCPs remain vulnerable to the bankruptcy of several clearing members. The increasing interconnectedness of digital assets with the traditional financial system is an emerging vulnerability. Asset

market vulnerabilities to technology disruptions are notable.

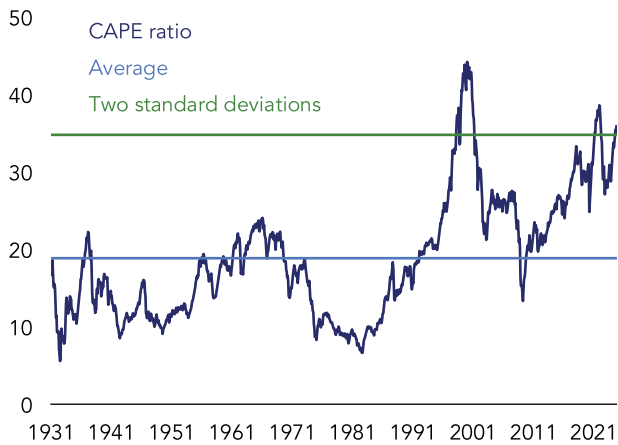
Equities

The U.S. equity market is the largest U.S. capital market. Approximately \$54 trillion in publicly traded U.S. corporate stock was outstanding as of June 30, 2024. Changes in equity prices are not themselves a threat to financial stability, but activities associated with the equity market, such as securities lending, do pose vulnerabilities that are related to price changes. A healthy U.S. equity market is an important component of well-functioning capital markets. Key participants in equity markets include U.S. companies, as well as individual and institutional investors.

The S&P 500 index, in particular, is considered a bellwether and a gauge of financial market health. A substantial share of equity investments is designed to track the S&P 500. Corrections in the S&P 500's value can have ripple effects across financial markets. A sharp drop in the index's value can cause a market-wide circuit breaker to engage and stop trading across U.S. equity markets, equity options, and equity futures exchanges. This makes the index systemically important.

Equity markets are known for their price volatility. The side effects of price volatility may threaten financial stability when, for example, valuations and sentiment are at extremes or leverage is high. Many valuation metrics are elevated compared to historical averages. The cyclically adjusted price-to-earnings (CAPE) ratio for the S&P 500, for example, is 36 and in the 98th percentile of historical values (**Figure 1-1**). Market sentiment is optimistic: more individual investors believe stock prices will be

Figure 1-1. Cyclically Adjusted Price-to-Earnings (CAPE) Ratio



Note: Data as of September 30, 2024. The CAPE ratio is the S&P 500 index divided by trailing 10-year average inflation-adjusted earnings.

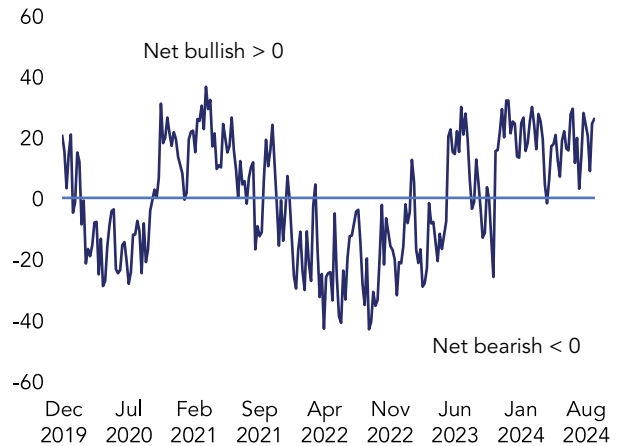
Sources: Robert Shiller, Haver Analytics, Office of Financial Research

higher in six months than believe stock prices will be lower (**Figure 1-2**).

The S&P 500 index returned a 21% gain year-to-date through September 30, 2024, partly driven by several firms with large weights in the index. About 45% of the gains, including dividends, were from just six stocks—Apple, Alphabet, Nvidia, Microsoft, Meta, and Amazon—with a heavy focus on AI. If the prices of those stocks are based on unrealistic expectations about profits associated with AI, the S&P 500 could fall sharply.

Some investors use leverage to amplify returns, which introduces a vulnerability. Large declines in equity prices can lead to large increases in margin loan collateral requirements, stressing some market participants (see **The Role of Margin**). Margin debt outstanding has risen 14% in 2024 through August, or less than the increase in the S&P 500 index. Furthermore, margin debt remains below its 2021 peak and has declined relative to the size of the U.S. equity market in recent years (**Figure 1-3**).

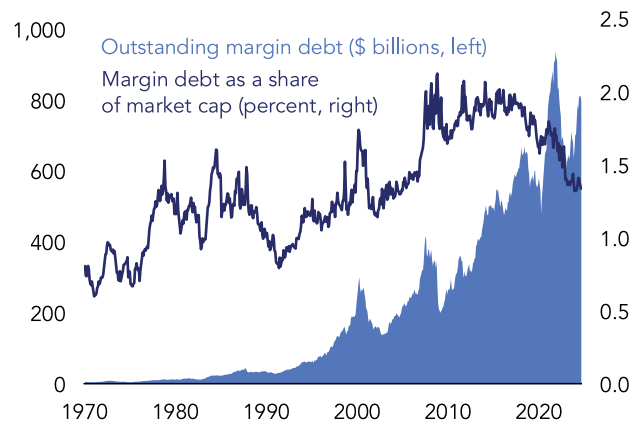
Figure 1-2. AAI Net Bull-Bear Sentiment (percent)



Note: Data as of September 26, 2024. Data reflect the percent of individual investors surveyed that believe the stock market will be higher (bullish) minus lower (bearish) in the next six months. AAI = American Association of Individual Investors.

Sources: American Association of Individual Investors, Bloomberg Finance L.P., Office of Financial Research

Figure 1-3. Margin Debt



Note: Data as of August 31, 2024. Market capitalization is for the New York Stock Exchange and the Nasdaq combined.

Sources: New York Stock Exchange, Bloomberg Finance L.P., Financial Industry Regulatory Authority, Board of Governors of the Federal Reserve System, Nasdaq, Haver Analytics, Office of Financial Research

The Role of Margin

Some borrowing and lending related to financial market activity involves collateral that is maintained under margin arrangements. At the time of the margin loan, the borrower provides collateral that often exceeds the loan's value. When the loan balance or the collateral value changes, the borrower may need to provide additional collateral or may withdraw some of the collateral already provided. If the borrower fails to repay the loan or provide extra collateral when required, the lender may sell all or part of the collateral and use the proceeds to satisfy the loan.

For example, an individual investor obtaining a retail margin loan from a brokerage firm is likely to find that the loan amount cannot exceed a fraction, say 50%, of the value of cash and securities in their brokerage account. A margin call might be triggered if the account value falls below another threshold, such as 150% of the loan amount. In that case, the investor might repay some of the loan, perhaps using proceeds from the sale of securities, or might transfer additional assets into the account.

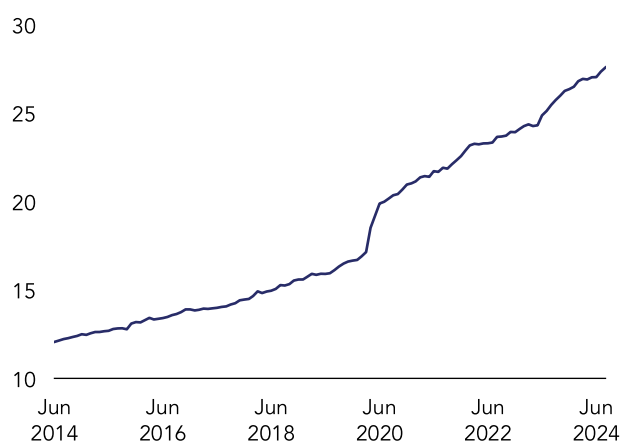
At the transaction or account level, margin arrangements are a sound risk management practice. They protect the lender from a borrower default as long as the value of the collateral does not change too quickly. At the level of a market or the financial system, margin arrangements can create a need for large flows of cash and other assets and can amplify price volatility. If asset price movements are large and rapid, changes in margin collateral requirements are also likely to be large and rapid. Some financial market participants may come under stress as they scramble to acquire assets suitable as collateral or liquidate assets to generate cash. If this happens at sufficient scale, the stresses can spread to other parts of the financial system. The role of margin as a source of vulnerabilities in the financial system is discussed throughout this report.

Treasuries

The U.S. Treasury market is the world's largest, deepest, and most liquid government securities market (**Figure 1-4**). As a result, it plays a critical role in global finance, providing risk-free benchmarks that are used to price many other financial instruments.

Treasury securities are widely used as a safe, liquid asset. For example, Treasuries are used for hedging interest rate risk at financial institutions, as a source of liquidity, as collateral, and to fund federal government guarantees. As a result, disruptions to this important market might be extremely disruptive to the global financial system.

Figure 1-4. U.S. Treasury Debt Outstanding (\$ trillions)



Note: Data as of August 31, 2024. Data are for marketable debt held by the public.

Sources: U.S. Department of the Treasury, Office of Financial Research

A particularly acute vulnerability stems from the type of debt ceiling currently in place in the United States. Raising or suspending the debt ceiling requires Congress to pass, and the President to sign into law, a bill to do so. A failure to raise or suspend the debt ceiling in a timely fashion could cause the Treasury General Account (TGA) cash balance to fall to a low level. The TGA is like a checking account for the federal government. If the balance falls too low, there could be insufficient funds to meet all of the government’s obligations, including payments for interest on the debt, Social Security, Medicare, and military expenditures.

In June 2023, the TGA cash balance fell to \$23 billion, the lowest level since 2015.² If the cash balance falls too low relative to the daily variation in revenues and expenses, Congress could have less time than expected to raise the debt ceiling. To date, the failure to raise the debt ceiling sufficiently far in advance has contributed to a downgrade of the U.S. government’s credit rating.

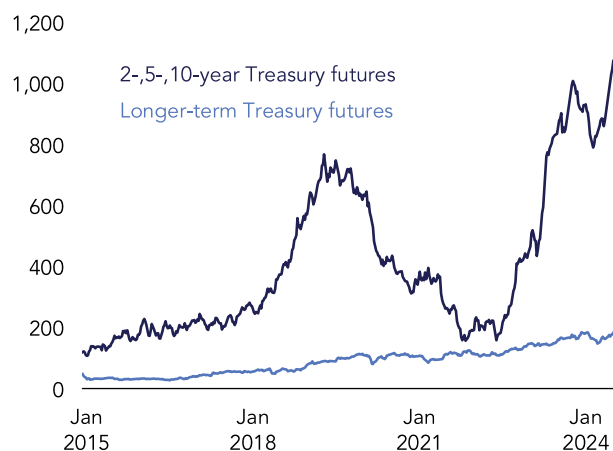
Trading liquidity in the Treasury market can become stressed in other circumstances as well. One potential source of stress is an abrupt unwinding of the Treasury cash-futures basis trade. This trade exploits the price differences between a Treasury security and a related Treasury futures contract—the cash-futures basis—by buying the relatively undervalued asset and selling the other asset in anticipation that their prices will converge. As the futures contract approaches maturity, the price of both legs of the trade should converge, guaranteeing a profit.

Risk arises from the basis trade because the profit on individual transactions is usually small, and investors often use leverage to achieve large positions. Most often, this is done by funding Treasury purchases in repurchase

agreement, or repo, markets. A repo is a contract in which a market participant sells an asset with an agreement to buy it back. Repos require posting extra collateral if the price of the Treasury drops. If collateral requirements rise and the trade, including the cost of leverage, becomes unprofitable, or if repo funding dries up, the investor may unwind the trade by selling the Treasury and buying an offsetting future. This happened en masse in March 2020, adding to market stress.

The volume of basis trade positions appears to have risen in 2024, increasing concerns about another large unwinding. Available data do not support precise measurement of the basis trade. However, one indicator of basis-trade activity is the size of hedge funds’ short positions in Treasury futures.³ In 2024, hedge funds’ short positions in 2-, 5-, and 10-year Treasury futures contracts rose to an all-time high (**Figure 1-5**). Meanwhile, hedge funds’

Figure 1-5. Hedge Funds’ Notional Value of Short Treasury Futures Positions (\$ billions)



Note: Data are for leveraged funds as of September 17, 2024, from the OFR Hedge Fund Monitor. Leveraged funds are typically hedge funds and various types of money managers, including registered commodity trading advisors, registered commodity pool operators, or unregistered funds identified by the Commodity Futures Trading Commission. The Ultra 10-year, 30-year, and Ultra 30-year are longer-term Treasury futures.

Sources: Commodity Futures Trading Commission, Office of Financial Research

short positions in futures with longer maturities remained fairly flat.

Corporate Bonds, Loans, and Securitizations

Larger companies may borrow funds by issuing bonds and syndicated loans, both of which trade in secondary markets. This debt falls into two broad categories: investment grade and high yield. The former is a large market in which companies with low default risk issue debt. The high-yield market, in contrast, is smaller. In this market, companies with a higher risk of default issue leveraged loans and bonds. Securitizations issue debt instruments to finance the purchase of a pool of assets.

Bonds, loans, and securitizations have the potential to contribute to financial instability if prices change rapidly, secondary market functioning becomes degraded, or losses are unusually large. Secondary markets permit investors to rebalance their portfolios. An inability to do so can interfere with the functioning of the broader financial system.

When widespread repricing of debt occurs, both secondary market functioning and the issuance of new debt can be degraded. Large default losses can impair the solvency of financial institutions.

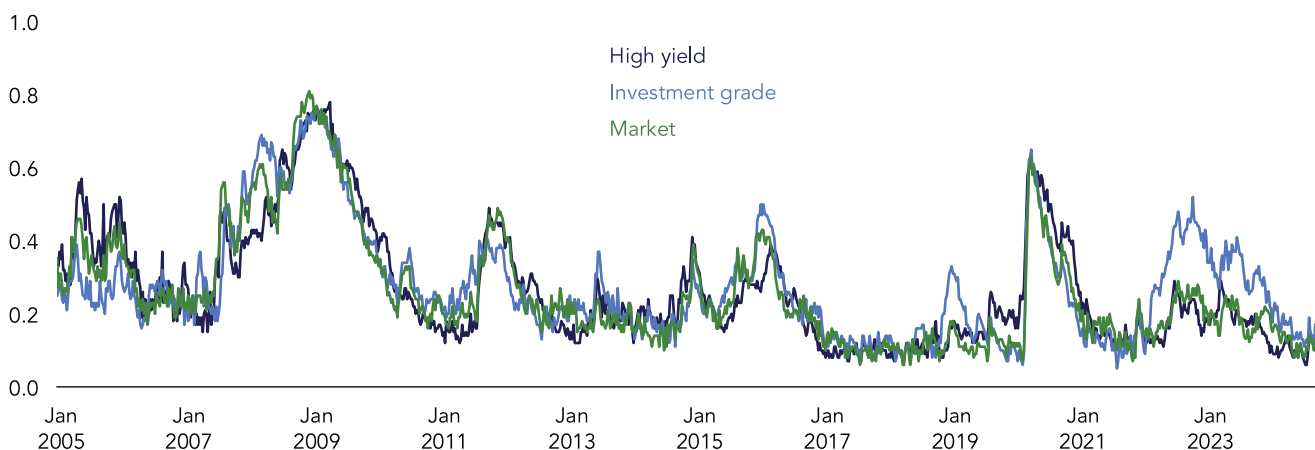
Corporate Bonds and Loans

Currently, both the high-yield and investment-grade bond markets are functioning well. The Corporate Bond Market Distress Index (CMDI), which combines a variety of distress measures from across primary and secondary markets, was in the 16th percentile of its historical distribution as of September 20, 2024 (**Figure 1-6**).

The difference between the yield on a corporate bond and that on a Treasury bond of similar maturity reflects the market's pricing of the corporate bond's credit risk and trading liquidity. This difference is known as the spread. The spreads on investment-grade and high-yield bonds are low by historical standards (**Figure 1-7**).

Credit default swap (CDS) spreads are another measure of credit risk. Indexes of CDS measure

Figure 1-6. Corporate Bond Market Distress Index



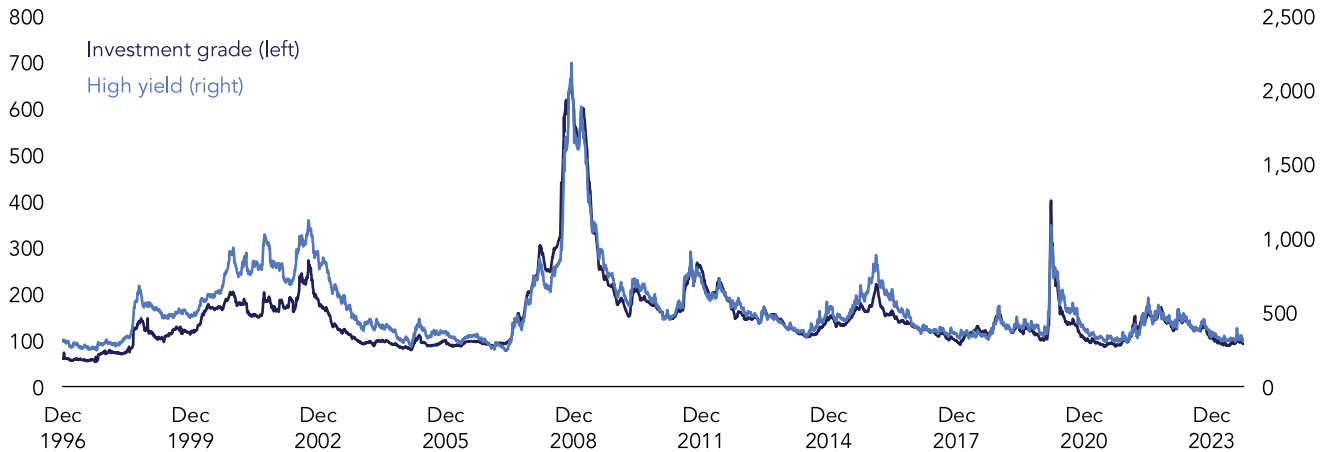
Note: Data as of September 20, 2024. The market is the total of high yield and investment grade. Higher index values indicate higher distress.

Sources: Federal Reserve Bank of New York, Office of Financial Research

market-wide default risk. When the volatility of the indexes is elevated, as it was in Q3 2024, investors are pricing in more uncertainty about credit risk (**Figure 1-8**).

The average cost of trading corporate bonds is currently low. This suggests that the liquidity of corporate bonds is high on average, although some individual bonds are illiquid (**Figure 1-9**).

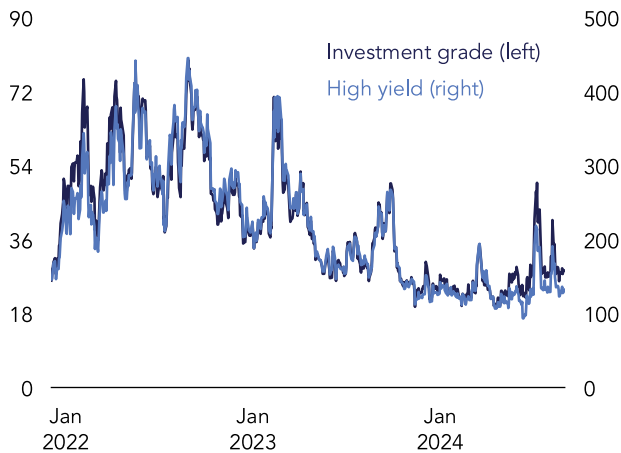
Figure 1-7. Corporate Bond Spreads (basis points)



Note: Data as of September 30, 2024. The series represent the option-adjusted spreads based on the ICE BofA U.S. corporate bond indexes for investment-grade (C0A0) and high-yield debt (H0A0).

Sources: ICE Data Services, Haver Analytics, Office of Financial Research

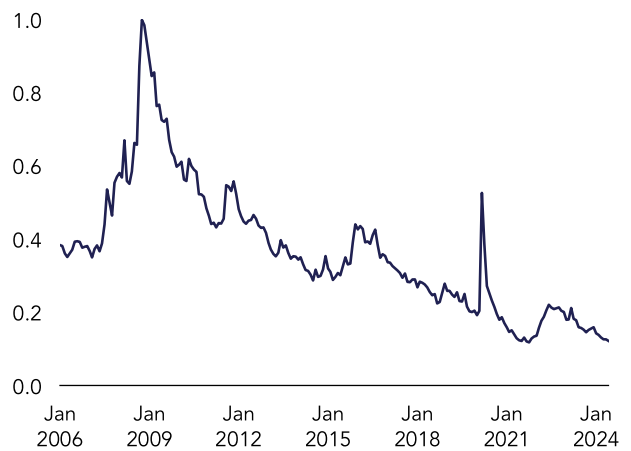
Figure 1-8. Implied Volatility Indexes



Note: Data as of September 30, 2024. February 29, 2012 = 100. Indexes reflect the CDX/CBOE N. American Investment Grade 1-Month Vol Index (VIXIG) and High Yield 1-Month Vol Index (VIXHY). The Credit VIX indices are intended to provide an annualized expected volatility number for the underlying CDS index spread changes in basis points.

Sources: S&P Global Limited, Bloomberg Finance L.P., Office of Financial Research

Figure 1-9. Average Cost of Trading Corporate Bonds (percent)



Note: Data as of June 30, 2024. The trading cost is measured as half the difference between the price at which dealers will sell a bond (the ask) and the price at which they will buy the bond (the bid), as a percent of the trade price.

Sources: Financial Industry Regulatory Authority TRACE, Office of Financial Research

Securitizations

Some securitizations pose pricing, design, and complexity risks for the financial system (see **What Is Securitization?**). Retail investors rarely buy instruments issued by securitization vehicles because they often lack the requisite specialized expertise. Even investors with such expertise could fail to properly analyze a securitization, which increases the risk of valuation errors and a disruptive repricing.

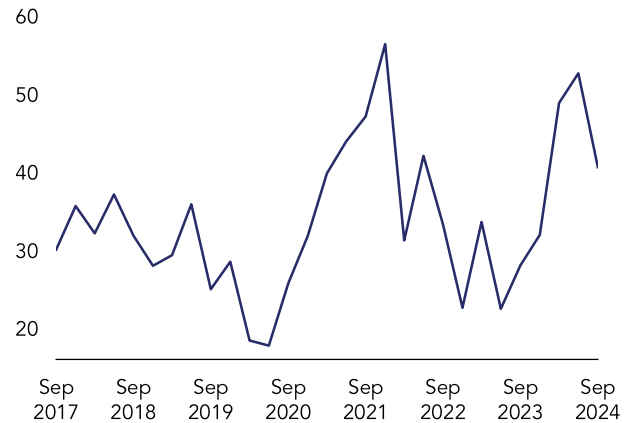
The design of tranching is also a source of risk. An investor may not understand the intricacies of how tranching allocates risk or that a tranche's rating may be misaligned with future loss experience.

Securitizations are more complex than ordinary corporate debt and come in many varieties. One vulnerability they pose is associated with their complexity and the possibility that the assumptions about risk that are embedded in securitization structures are wrong. If investors learn that they have misunderstood a securitization's structure or the risks of its pool of assets, there may be less liquidity in related primary and secondary markets. Investors will have difficulty rebalancing their portfolios, and funding for real-economy activities like homebuying and business investment will be constrained.

Collateralized loan obligations (CLOs) are an example of complex securitizations. These provide funding for a substantial share of leveraged loans. The volume of CLOs outstanding has grown steadily. CLO issuance, which is more variable, has grown during the past year (**Figure 1-10**).

Market value CLOs, of which few remain, are an example of securitizations that were not fully understood. In 2007-08, many market value CLOs were forced to liquidate because the

Figure 1-10. CLO Issuance (\$ billions)



Note: Data as of September 30, 2024.

Sources: PitchBook LCD, Office of Financial Research

market price of the leveraged loans they held had fallen below trigger levels built into the securitizations' structures. The resulting fire sale of leveraged loans forced the loans' market prices down to less than 65 cents on the dollar on average, a level below their intrinsic value.⁴ The ability to issue new leveraged loans was impaired. Investors in market value CLOs either did not understand the embedded market price triggers or did not properly evaluate the risk that market prices would fall below the trigger values.

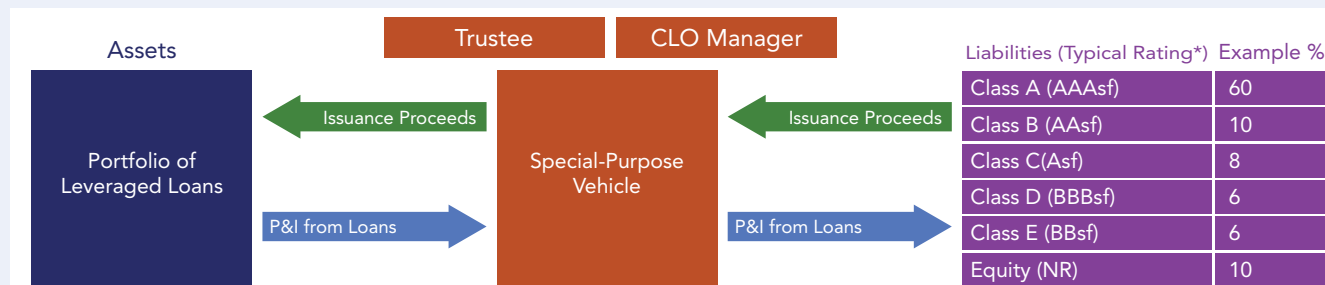
Securitizations also are subject to the vulnerabilities associated with most debt instruments. Large, rapid changes in credit losses, credit risk, interest rates, or market prices may disrupt the normal functioning of primary and secondary securitization markets.

What Is Securitization?

The typical securitization converts a pool of many individual debt instruments into a small number of securities that partition the risks of the pool. Creating a securitization is a way for financial institutions to manage their risk, to obtain an off-balance-sheet source of funding, or to arbitrage the prices of different levels of risk. Securitization also allows investors with different risk tolerances to invest accordingly.

For example, a CLO manager buys stakes in a few hundred mostly high-risk corporate loans for a special purpose vehicle (SPV) that operates under a set of well-defined rules. The SPV pays for the loans using money received from the issuance of new debt. The new debt segments the pool's future credit losses across multiple tranches. Investors in the most senior tranche, rated AAA or equivalent, will fail to receive full principal and interest only if credit losses are extremely severe. In contrast, investors in the most junior tranche, the unrated residual tranche, absorb normal credit losses but receive correspondingly high interest rates. If losses are higher than expected, investors in the residual tranche may receive little or nothing, and investors in the next-riskiest tranche will experience losses. As losses on assets in the pool increase, investors' positions in successively senior tranches will be wiped out. The diversification the CLO offers is not the main service investors receive because any large investor could simply buy the loans in the pool. Investors benefit because those seeking high, medium, or low interest rates and associated levels of risk can find these among the tranches (**Figure 1-A**).

Figure 1-A. Structure of an Arbitrage CLO Transaction



Note: The CLO manager typically contributes a portion of equity. *The sf is Fitch's signal that a letter rating is for a structured finance instrument. Moody's and S&P use (sf).

Source: Office of Financial Research

Many other types of securitizations exist. For example, mortgage-backed securitizations with pools of mortgage loans purchased by Fannie Mae or Freddie Mac typically have very little credit risk because they guarantee the payment of principal and interest on their mortgage-backed securities (MBS). Investors, however, do bear prepayment risk. Tranching is designed to distribute that risk.

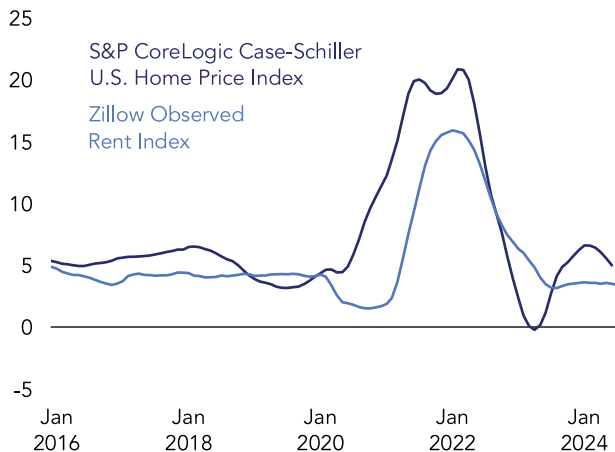
Real Estate Markets

Residential and commercial mortgages are collateralized by physical real estate. The value of the collateral affects borrower incentives to repay. If property prices fall and, correspondingly, mark-to-market loan-to-value (LTV) ratios increase such that many real estate owners no longer have equity in their property, defaults are likely to rise, imposing losses on lenders and investors. Whether or not physical real estate markets are disrupted, the markets for traded debt that is related to real estate, such as MBS, may be disrupted.

Residential Real Estate

Home prices, after growing at an average annual rate of 13% from 2020 through 2022, appreciated 5.0% for the 12 months through July 2024 (Figure 1-11). Higher mortgage interest rates and reduced affordability contributed to the change. Recently, home price growth has outpaced the growth in rental rates.

Figure 1-11. Home Price Appreciation and Rent Growth (percent)



Note: Data as of July 31, 2024. Values are year-over-year growth rates in the price indexes.

Sources: S&P Dow Jones Indices LLC, S&P CoreLogic Case-Schiller, Federal Reserve Bank of St. Louis FRED, Zillow, Office of Financial Research

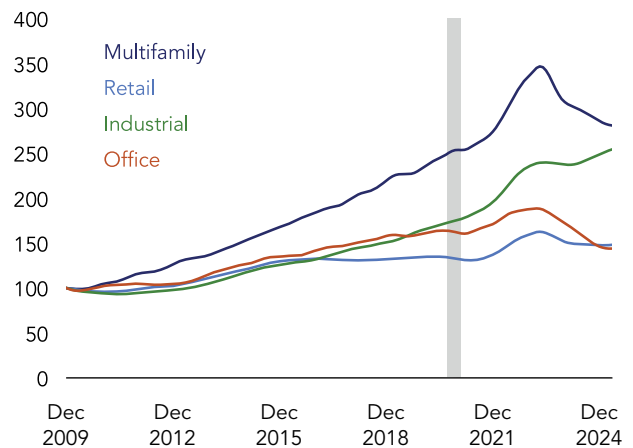
Between 2016 and 2024, home price appreciation generally exceeded annual inflation, which is not unusual. Although this made houses less affordable for many potential first-time buyers, home equity increased for most existing homeowners. Greater home equity reduces the likelihood that homeowners will default on their mortgages. If house prices start to decline, the risk of mortgage default may increase.

Commercial Real Estate

CRE price appreciation has varied by property type. During the five years through August 2024, industrial property prices rose about 53%, retail property prices rose 10%, and office property prices fell about 11% (Figure 1-12).⁵ These differences reflect the demand for space of each type.

Focusing on offices, about half as many employees are physically working in the office compared with before the COVID-19 pandemic. Although this does not necessarily

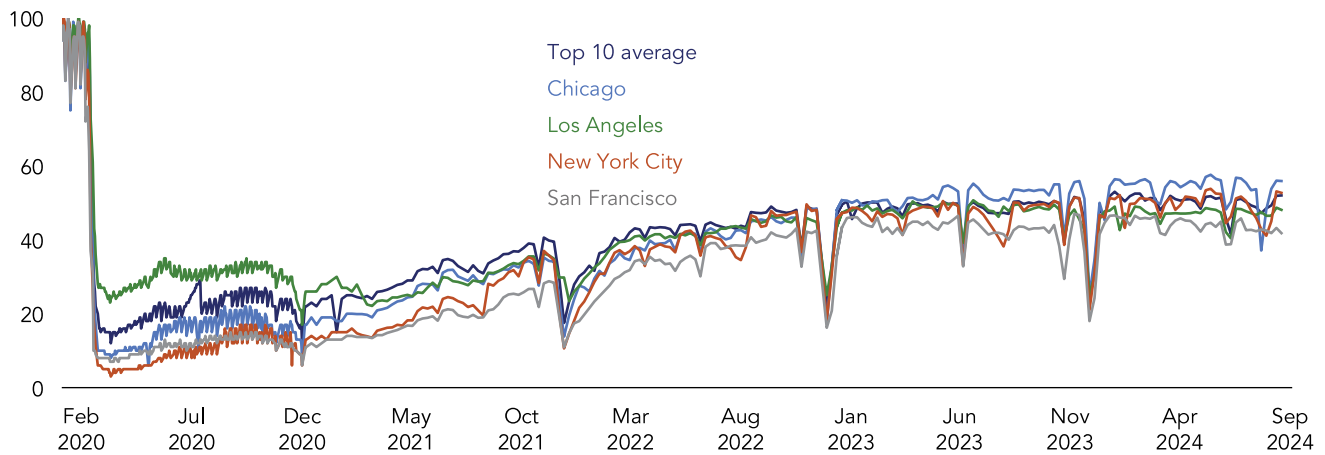
Figure 1-12. Commercial Real Estate Price Trends (indexes)



Note: Data as of August 2024. December 31, 2009 = 100. Shaded area is U.S. recession (NBER).

Sources: MSCI Real Capital Analytics, National Bureau of Economic Research, Haver Analytics, Office of Financial Research

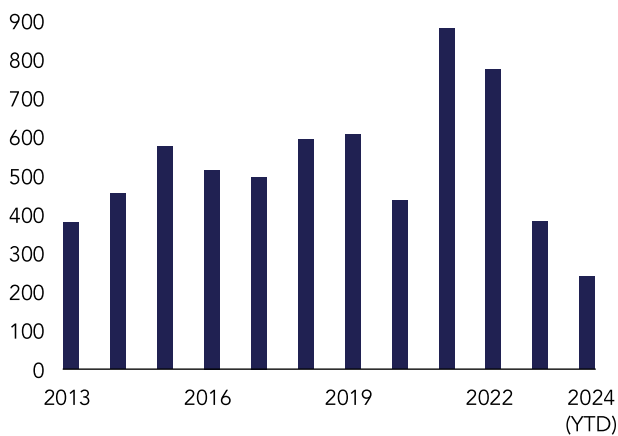
Figure 1-13. Estimated Office Space Occupancy (percent)



Note: Data as of September 18, 2024. Data are from the Kastle Back to Work Barometer and are daily in 2020 and weekly thereafter.

Sources: Kastle Systems, Haver Analytics, Office of Financial Research

Figure 1-14. Commercial Real Estate Transaction Volume (\$ billions)



Note: Data as of August 2024. YTD = year to date.

Sources: MSCI Real Capital Analytics, Office of Financial Research

mean that half the space is needed, a surplus of office space exists (**Figure 1-13**). As a result, both rents on new leases and the price of office buildings have fallen on average. Because office buildings are long-lived and difficult to convert to other uses, the lower prices are likely to persist.

Uncertainty about the value of office buildings and other types of CRE has also increased.

Transaction volume for all CRE has fallen, making the accuracy of indexes as an indicator of changes in property values less reliable (**Figure 1-14**).

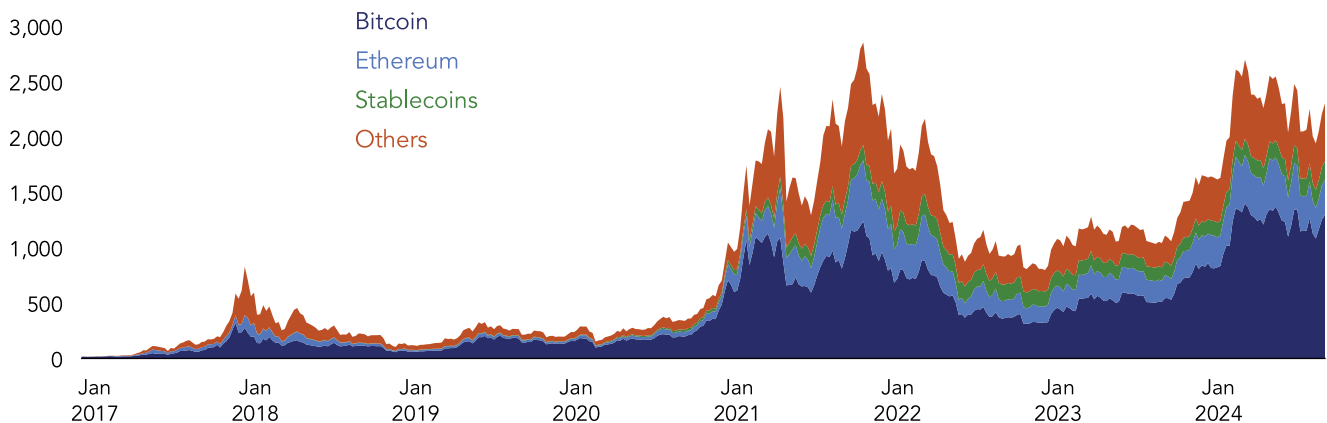
Traded Securitized Real Estate Debt

A large share of newly originated mortgages is securitized. This is especially true for residential mortgages that conform to the requirements of programs such as those offered by Fannie Mae, Freddie Mac, and the Federal Housing Administration. A smaller share of commercial mortgages is also securitized. The securitized debt is priced in financial markets, and any reduction in the trading liquidity of MBS or commercial mortgage-backed securities (CMBS) may impair price discovery and the ability to securitize new debt. The quarterly average daily trading volume of MBS was up 22% in Q2 2024 from a year earlier.

Digital Assets

Crypto assets account for the majority of digital assets outstanding (**Figure 1-15**). Bitcoin is the largest crypto asset.

Figure 1-15. Total Crypto Asset Market Capitalization (\$ billions)



Note: Data as of September 29, 2024. Weekly crypto assets market capitalization reported every Sunday.

Sources: CoinMarketCap, Office of Financial Research

Vulnerabilities associated with digital assets depend on the strength of connections between digital assets and the traditional financial system. As seen in 2022-23, digital assets and their markets have structural vulnerabilities that increase the likelihood and severity of instability. However, the connections between failed digital entities and the traditional financial system became clear only after the fact, implying ongoing uncertainty about the strength of such connections.

Bankruptcy documents, for example, show that many financial institutions, including banks, were creditors of the bankrupt digital exchange FTX Trading, Ltd. (FTX).⁶ The three largest banks that failed in 2023 all provided services to firms active in digital assets. The estimated costs of the three failures to the FDIC's deposit insurance fund were about \$39 billion.⁷ While crypto activities were only one contributor to these failures, at least some losses borne by the deposit insurance fund were likely attributable to these activities. If connections continue to multiply, trouble in the digital asset realm may cause material instability in the traditional financial system.

Conversely, instability in traditional markets can also cause disruptions in the digital assets space. For example, at the time of Silicon Valley Bank's (SVB's) failure, the bank was holding more than \$3 billion in uninsured deposits on behalf of a large stablecoin issuer—Circle (issuer of the stablecoin USDC). The failure of SVB contributed to USDC temporarily losing its dollar peg on the open market.

Some financial firms are extensively involved in digital assets. Asset managers continue to announce new pooled investment vehicles, including mutual funds and exchange-traded funds (ETFs), that invest directly or indirectly in digital assets. They also provide services to and hold equity in digital asset firms and pay them for services.

The cascade of events following each failure in the digital assets space during 2022-23 highlighted challenges in understanding risks in the sector. Examples include a lack of transparency, complex corporate structures, governance issues, conflicts of interest, and interconnectedness through opaque cross holdings and circular lending practices. Although existing laws and regulations apply to

some crypto assets and related activities, gaps in regulatory authority remain.⁸

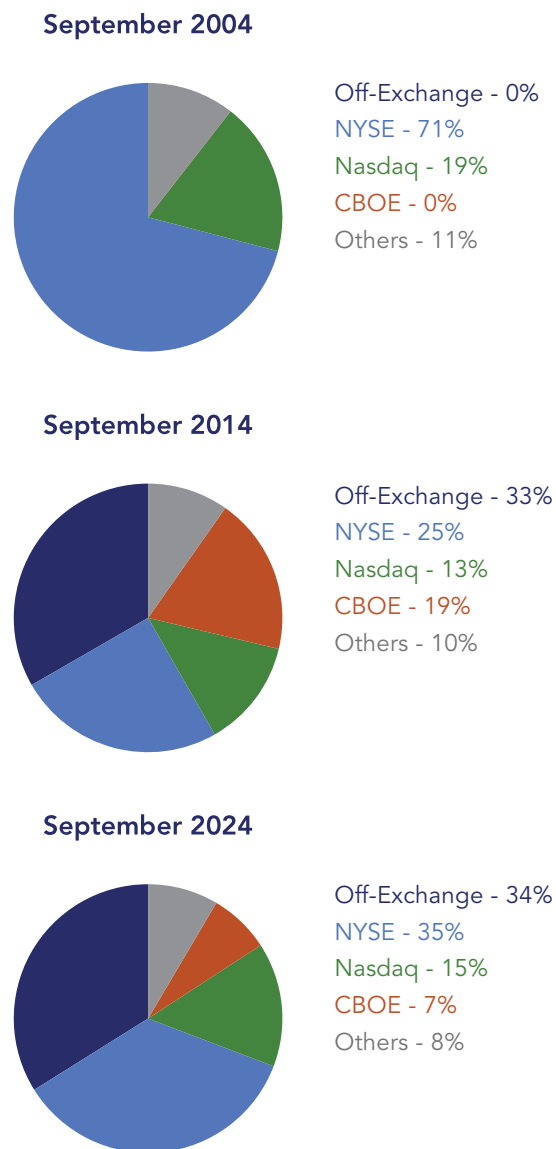
The financial stability risks of digital assets were amplified in 2022 when Ethereum adopted the Proof of Stake (PoS) protocol. PoS is a process for validating digital transactions. Rather than solving energy-intensive computational problems, validators must make substantial investments in the crypto asset being validated. OFR researchers find that while PoS saves energy and provides for greater scalability of a crypto asset, it may be unstable because a significant drop in the crypto asset's price may cause validators to exit their investments.⁹ Their exit may impair the tradability of the crypto asset, which in turn may cause more validators to exit. This exiting resembles a bank run. In the case of Ethereum, such an event would disrupt activity relying on the Ethereum network, including many crypto firms and DeFi networks.

Exchanges and Trading Platforms

Exchanges and trading platforms provide a marketplace for buying and selling, increasing the accessibility and efficiency of asset trading. These platforms act as intermediaries, connecting buyers and sellers and facilitating transactions. They centralize the price discovery process for assets through a standardized order format that can facilitate greater understanding of demand, supply, and liquidity.

U.S. equity markets have seen growth in the number of trading venues and, with that growth, more points where a lack of substitutes could pose a threat. The number of transactions occurring outside of the traditional exchange system, or off-exchange, is substantial (**Figure 1-16**). Growing fragmentation may provide some operational resilience. Trading on one exchange may

Figure 1-16. Market Share by Exchange



Note: Totals may not add to 100% due to rounding.

Sources: Muzan Trade and Quote, Office of Financial Research

continue if trading on another is disrupted. At the same time, off-exchange venues do not provide pre-trade transparency; they do not report quotes, only completed trades.

For exchanges, market fragmentation may pose a risk to liquidity and price discovery.¹⁰ Existing exchanges receive fewer orders as investors split their transactions across many venues. Fewer orders could further discourage investors

from participating at the exchanges. With more than a third of all transaction volume occurring off-exchange, market functioning may be more vulnerable to price impacts from fire sales because dealers operating off-exchange have less obligation to facilitate trades. During extreme market events, dealers could stop providing sufficient liquidity off-exchange, forcing investors to search elsewhere.

Finally, the growth in off-exchange transactions also lowers access to real-time information about security prices. Exchanges provide pricing information that is usually not available from off-exchange venues. This information helps those who own securities, but do not wish to sell, understand their portfolio's value and its risk. The growth of off-exchange trading draws liquidity away from the exchanges that release this information, making liquidity, volume, and prices less transparent.¹¹

Equity and fixed-income securities trade in different ways. Instead of relying on centralized venues, as is the case with most equity trades, fixed-income trading usually is decentralized and could require a trader to contact many dealers. During periods of high fixed-income price volatility, some dealers are less willing to offer quotes or offer quotes with very wide bid-ask spreads. These actions impair price discovery and investors' ability to rebalance portfolios.

The adoption of electronic trading varies significantly by asset type. About two-thirds of transaction value in the U.S. Treasury market, for example, takes place electronically.¹² Corporate bonds have also adopted electronic trading, but more than half of all volume still relies on requests not made electronically. MBS and asset-backed securities (ABS), likely due to their highly varied nature, have seen minimal transition to electronic trading.

Securities Lending

A market participant can borrow a security it needs but does not possess. The borrower provides the lender with collateral to reduce the lender's risk of loss if the security is never returned. Borrowers' motivations vary and include the potential to profit from an expected price decline through a short sale or, for equity securities, the ability to secure voting rights without buying the security.

Financial stability risks are influenced by securities lenders' ability to quickly return collateral. The lender owns the collateral provided by the borrower. Often, the collateral is cash, and the lender can place it into short-term money market investments. If security prices move significantly, then many borrowers may decide to return securities they have borrowed to their lenders. The lenders must quickly return the collateral and typically liquidate the associated investments. For example, if many stocks experience large price changes, flows out of short-term money markets might be large. Moreover, if the securities lender puts the collateral in illiquid investments and the investments fall in value, the lender will bear the loss. In the worst case, these dynamics can weaken the securities lender, often a large financial institution, and have potential knock-on effects for the financial system.

The securities lending vulnerability is structural and varies mainly with the volume of such lending. The total value of U.S. equity securities on loan was about \$650 billion at the end of 2023. While securities lending volumes have increased steadily since the 2007-09 financial crisis, the number of shares available to be lent has increased faster. Overall, aggregate loan utilization has fallen over time to approximately 3% (**Figure 1-17**), reducing the vulnerability.

Figure 1-17. Aggregate Loan Utilization over Time (percent)



Note: Data as of August 2024. Stock-level loan utilization is measured as the ratio of the value of the loans to the value of tradeable securities outstanding.

Sources: S&P Global Limited - Securities Finance, Center for Research in Security Prices, Office of Financial Research

Central Counterparties and Clearing

CCPs facilitate trading and manage associated risks by clearing transactions between their members and collecting collateral to ensure the performance of outstanding contracts. Central clearing helps reduce the chance of financial instability when a major counterparty does not perform. The share of transactions that are centrally cleared has increased dramatically during the past 15 years, largely due to global regulatory requirements.

A CCP stands between the two parties to a transaction. The CCP becomes the buyer to the seller and the seller to the buyer. If one counterparty fails, the CCP ensures that the contract terms are satisfied. Collateral is collected in advance of a price change (initial margin and default fund contributions) and following a price change (variation margin). If one party fails, the CCP uses the collateral posted by the defaulting party, as well as other resources at its disposal, to satisfy its obligations to the other party.

Without CCPs, the failure of a large market participant would be disruptive to each of its counterparties and require resolution with each of them, a complex process. CCPs reduce that complexity by serving as a single common counterparty with a specified resolution process. They provide transparency and help ensure reliable transaction processing, which is essential for market functioning.

However, the centrality of CCPs also poses systemic risk because most securities or derivative markets have one or two CCPs that clear specific instruments globally. Thus, many CCPs serve as a single point of failure for more than just their domestic financial system and can pose global risks. There is considerable overlap in the membership of different CCPs, so stress at a member of one CCP can cause stress at multiple CCPs. The failure of a major CCP would be a systemic event.

Because CCPs have narrow business models and are highly regulated, the failure by a CCP to satisfy its obligations is most likely to occur in two ways. The first is the failure of one or more of a CCP's clearing members. The second is a major operational disruption at a CCP or one of its members, such as from a successful cyberattack. Regulators have been attentive to the risks associated with such events.

CCPs have a variety of resources to cope with losses associated with failures of clearing members. The resources collectively support the successive lines of defense that constitute a CCP's default waterfall. The waterfall stipulates the sequence in which the resources are drawn upon to cover the unsatisfied financial obligations of defaulted clearing members.

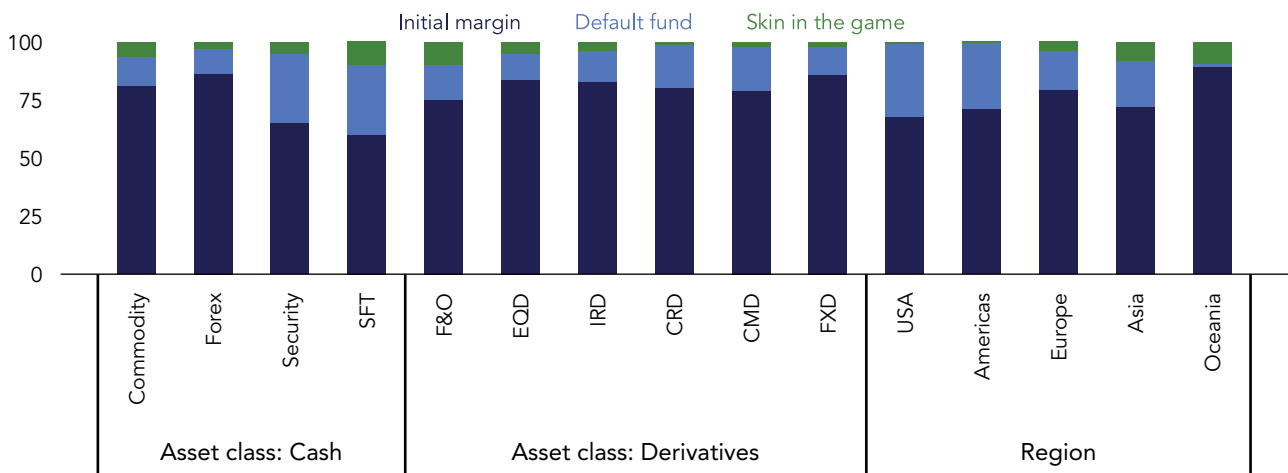
The size and composition of default waterfalls differ significantly across CCPs that clear different financial instruments and that are located in various geographical areas (**Figure**

1-18). Initial margin constitutes about 60% to 80% of the prefunded portions of CCP waterfall resources across locations and asset classes. Skin in the game, a CCP's contribution of its own funds to its waterfall resources, constitutes a very small share.

Differences in the size and composition of default waterfalls across CCPs affect the

potential for a CCP default. However, there is no way to measure the default probabilities because CCP failures rarely occur. Confidential survey data collected by the Federal Reserve System provide quarterly estimates of CCP default probabilities as calculated by CCP members (Figure 1-19). Implied default probabilities have fallen to low levels.

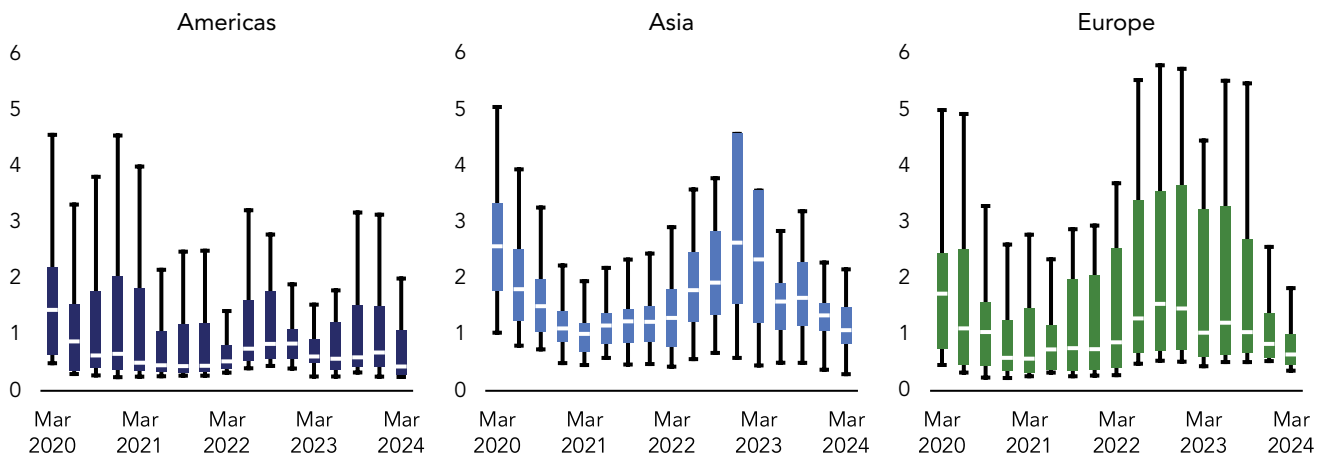
Figure 1-18. CCP Prefunded Resources (percent)



Note: Data as of June 30, 2024. SFT = Secured Financing Transactions. F&O = Futures and Options. EQD = Equity Derivatives. IRD = Interest Rate Derivatives. CRD = Credit Default Swaps. CMD = Commodity Derivatives. FXD = Foreign Exchange Derivatives.

Sources: Clarus Financial Technology, Office of Financial Research

Figure 1-19. CCP Members' Estimates of Default Probabilities by Region (percent)



Note: Data as of March 31, 2024. The top and bottom bars represent the 75th and 25th percentile, respectively, while the white line between them shows the median default probability. The error bars show the 5th and 95th percentile default probabilities.

Sources: Federal Reserve Y-14 Schedule L, Office of Financial Research

CCPs can also create stress in a market due to the liquidity demands they place on clearing members and their clients. For example, when volatility increases, calls for additional variation margin increase due to the larger moves in asset prices. Simultaneously, CCPs increase their initial margin requirements, and these are passed on to clearing members and their clients. During the market uncertainty at the onset of the COVID-19 pandemic, clearing members were able to meet demands for more margin, but some of their clients struggled.

Technology

Technology is essential to asset markets. Since the 1971 launch of the Nasdaq, the first electronic share market, technological advances have transformed financial markets with increasing speed. Electronic trading brings speed to markets, and with each advancement, information like prices and quotes is exchanged at a faster clip. Networked computer systems expand access to the financial system, connecting traders across the globe. Technology also offers a certain degree of operational resilience by shifting steps in the provision of digital services to companies that specialize in providing those steps.

Despite these benefits, technology makes asset markets vulnerable to disruption if it fails to operate as expected. The existence of systemically important elements in asset markets amplifies the vulnerabilities. As bellwethers, Treasury markets and the S&P 500 index are systemically important. So too are FMUs, CCPs, exchanges, and trading platforms. Technology outages that prevent one of these single points of failure from functioning can disrupt financial stability.

Technology can cause vulnerabilities even if it operates as expected. When the same

technology is widely used and provides the intended services, herd behavior can occur and increase price volatility.

In this section, a few of the channels through which a technology vulnerability can stress asset markets and possibly transmit stress across the financial system are discussed.

Trading

Market functioning requires the ability to trade, clear, and settle. More trading venues means more places to trade during a technology outage. It also means greater reliance on TSPs that are essential for moving funds across venues and asset market functioning.

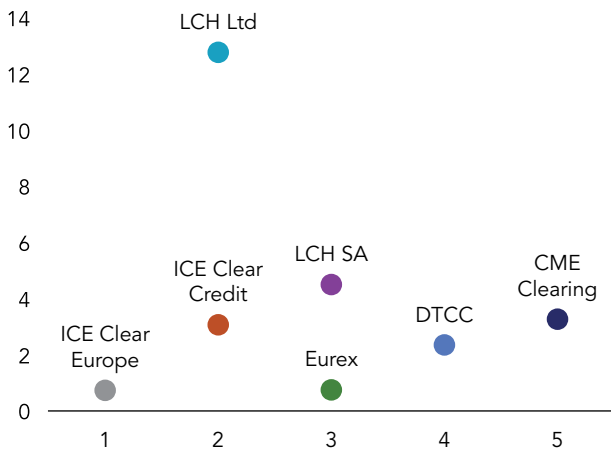
Technology-related disruptions in asset markets can affect a large share of market activity. The digitization of asset markets has enabled the provision of technology as a service—and with it, the rise of TSPs. Digital services can be provided at little to no marginal cost, which leads to concentration in their provision. As a result, TSPs can play a critical role in asset markets, and a technology service outage at one can disrupt a larger share of trading.

For example, in November 2023, Industrial and Commercial Bank of China Financial Services (ICBCFS) experienced a ransomware attack.¹³ ICBCFS provides clearing, execution, and financing services for institutional clients globally. It immediately took affected systems offline. Bank of New York Mellon (BNY), which is the sole settlement agent for Treasury securities, separately disconnected ICBCFS from its platform. ICBCFS's customers resorted to manual methods to determine the status of their trades and rerouted new trades, but the outage was felt in Treasury markets. The day after ICBCFS went offline, Treasury failures-to-deliver rose 144% from the day before and hit an eight-month high. Although ICBCFS

is considered a relatively small participant in Treasury markets, the effect of its service outage highlights the vulnerability of asset markets to technology risk.

As another example, in Q1 2024, LCH Ltd, which clears a wide range of assets worldwide, experienced two operational failures that lasted almost 13 hours in total. One exceeded the firm’s two-hour recovery time objective. The brief target recovery time indicates the criticality of a CCP maintaining its operations and the risk associated with outages (Figure 1-20).¹⁴

Figure 1-20. Total Duration of Operational Failures at Top CCPs (hours)



Note: Data are for the four quarters ending March 31, 2024. The x-axis represents the number of operational failures.

Sources: Clarus Financial Technology, Office of Financial Research

In June 2024, a problematic software update caused a Security Information Processor (SIP) to erroneously report that prices had fallen by as much as 99.7% for certain New York Stock Exchange (NYSE) stocks. SIPs are a critical TSP for asset markets. They collect, process, and disseminate trade and price information as a single consolidated data feed. Aggregating these data from disparate sources is vital to price setting, routing decisions, and risk management. SIP disruptions have occurred, and in many cases, they interrupted trading

and the flow of capital until the problems were resolved. This is what happened in June. The disruption caused the NYSE to cancel trades that had otherwise been matched and reported. It also triggered trading halts in up to 40 listed stocks on the NYSE Group exchanges.

In May 2024, the United States shifted to T+1 settlement for most traded securities.¹⁵ This shift may amplify the effects of operating outages. While T+1 settlement has many benefits, it also reduces the buffer that market downtime offers for recovering from technology outages. With cyberattacks, which can be timed and targeted to cause maximum disruption, built-in system downtime can be especially helpful for recovery efforts.

Price Discovery and Liquidity

Technology outages that disrupt trading necessarily prevent price discovery as well, but price discovery and liquidity can be disrupted even when technology works as designed.

A key technology vulnerability across markets is the growing role of automated trading systems. These systems include high-frequency trading (HFT) and algorithmic trading. HFT has been around for years, and advances in computing have made its use and the use of algorithmic trading systems commonplace. Algorithmic trading uses sophisticated models to rapidly place orders after analyzing large volumes of data. Innovations in algorithmic trading have introduced AI and machine learning models into HFT. These models are even more complex; they trade based on patterns observed in the data that are often not recognized by the people supervising them. All variants of HFT and algorithmic trading systems taken together likely account for a significant share of daily trading volume in equity, foreign exchange, and Treasury markets.¹⁶

Liquidity is perhaps the biggest concern. HFT is believed to improve market liquidity by narrowing bid-ask spreads, reducing volatility, and improving price discovery. At the same time, HFT activity may disappear during periods of high volatility. Liquidity provided by HFT is not the same as liquidity provided by traditional market makers. The small size of quotes creates a lack of depth, and HFT firms have no market-making obligation. If there are fewer traditional market makers because of the narrower bid-ask spreads that HFT brings about, then liquidity could decline if large losses suddenly accumulate and HFT firms leave the market.

Another concern is that automated trading systems will distort asset prices and amplify volatility. AI and machine learning models may be trained on new and unusual data that may have inconsistencies, measurement error, and biases. Algorithms based on the same or a similar model and trained on the same or similar data can execute the same trades, adding to market volatility. They also can place the same trade in reaction to news or events, whether real or fake. Automated trading systems make markets susceptible to volatility and steep price declines, even flash crashes. The widespread availability of generative AI amplifies this risk.

2. Businesses and Households

Businesses and households need a healthy financial system to support their activities. The financial system provides credit to borrowers with the expectation that borrowers will repay their debts. When borrowers do not repay, their delinquencies and defaults create stress that can be transmitted to financial institutions and markets. When defaults rise, credit conditions often tighten, further constraining business and household spending and balance sheets.

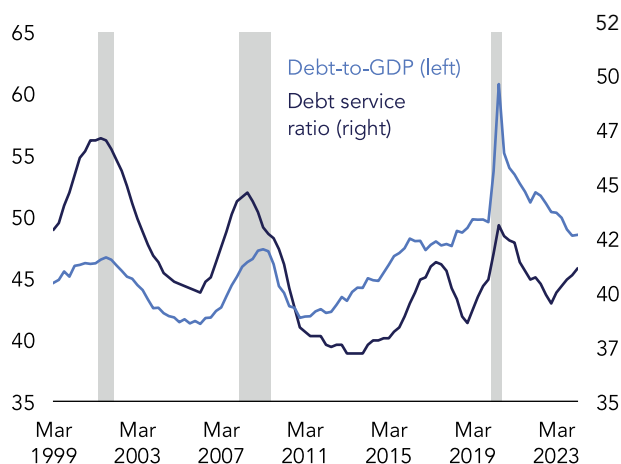
Vulnerabilities associated with business and household financing differ across types of borrowers. The volume of business debt posing a high risk of default has been trending higher, although it remains below the peak during the COVID-19 pandemic. Most CRE loans are performing, although delinquency rates are rising. Loans on many office properties, in particular, face a relatively high risk of default. The majority of household debt poses very low risk of credit losses, with subprime borrowers the exception. Debt outstanding has been growing rapidly for subprime borrowers, and delinquency rates on that debt are high and rising. Technology vulnerabilities became strikingly apparent in 2024 when service outages at technology providers disrupted entire industries' operations and receipt of payments.

Business Borrowing

Business debt provides important support for the growth and operation of nonfinancial firms in the United States. At about \$21 trillion for Q2 2024, nonfinancial business debt outstanding is similar to household debt outstanding; only government debt is larger than each of them. Nonfinancial corporate debt balances have increased over the past few years, but as a percent of nominal gross domestic product (GDP), they have declined

from the 2020 peak (**Figure 2-1**). Debt service burdens have risen in recent quarters due in part to higher interest costs but are below the peaks of recent business cycles.

Figure 2-1. Nonfinancial Corporate Debt



Note: Debt-to-GDP ratio as of June 30, 2024; debt service ratio as of March 31, 2024. Shaded areas are U.S. recessions (NBER). Debt service ratio is the ratio of debt payments to income.

Sources: Board of Governors of the Federal Reserve System, Bank for International Settlements, Bureau of Economic Analysis, Haver Analytics, National Bureau of Economic Research, Office of Financial Research

Nonfinancial corporate business debt contributed to financial instability at least three times during the past 40 years: 1989-91, 2000-02, and 2007-09.¹⁷ Each episode featured a mix of unusually high borrower default rates and constraints on weaker firms' ability to issue or renew debt. Often, the two interact and form a debt-default spiral. High default rates weaken lenders, which reduces their willingness to lend. Borrowing constraints weaken borrowers, which further worsens default rates. Secondary market trading activity was limited at some points during the episodes. The vulnerabilities associated with credit risk and trading liquidity are always present.

Credit losses on total business debt are less a function of average default risk, and more a

function of the fraction of business debt that poses a high risk of individual default. Business debt can be divided into two categories: investment-grade debt posing lower risk of default and high-yield or leveraged debt posing a higher risk. Investment-grade borrowers have a credit rating of BBB- or higher. In contrast, high-yield borrowers have a credit rating of BB+ or lower. Both categories include several types of debt contracts (for example, bonds and loans). Funding is provided by many types of lenders, including banks, insurance companies, investors in securitization vehicles, and private lenders.

Investment-Grade Debt

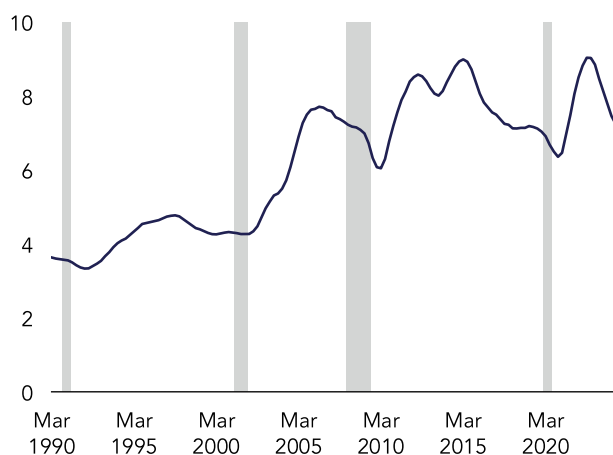
Vulnerabilities associated with investment-grade credit risk are low. However, investment-grade debt remains vulnerable to the disruption of secondary market liquidity, which tends to occur when other parts of the financial system are distressed.

Investment-grade firms have lower debt-to-cash-flow ratios and higher interest coverage ratios than high-yield firms. The interest coverage ratio has fluctuated since 2010 but is higher than in the 1990s (**Figure 2-2**). The share of investment-grade debt rated BBB, the riskiest rating for investment grade, has generally trended higher since 2008 (**Figure 2-3**). At the end of Q3 2024, the share was 46%. However, because the default rate on BBB rated debt is low (on average 0.23% annually since 1920), vulnerabilities related to investment-grade credit risk are muted.

High-Yield Debt

Vulnerabilities associated with high-yield credit risk have been growing with the share of high-yield corporate debt that is rated B and riskier. That share is volatile but has been trending higher in recent years (**Figure 2-4**). The average annual default rate of firms rated B since 1920 is 3%, far higher than default rates for investment-grade firms and about three times higher than

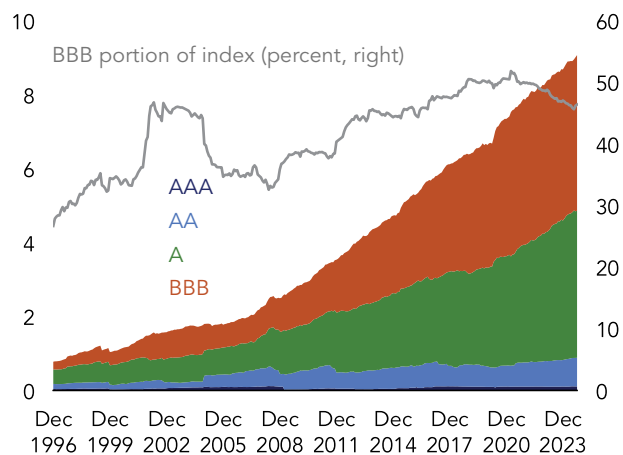
Figure 2-2. Investment-Grade Interest Coverage Ratio



Note: Data as of June 30, 2024. Shaded areas are U.S. recessions (NBER). Interest coverage is earnings before interest and taxes, divided by interest expense. The data reflect companies with investment-grade ratings from S&P Global Ratings.

Sources: Compustat, National Bureau of Economic Research, Office of Financial Research

Figure 2-3. U.S. Investment-Grade Corporate Debt by Rating (\$ trillions)



Note: Data as of September 30, 2024. The index is the ICE BofA US Corporate Index, which includes financial firms. Each rating category includes debt with + or - rating modifiers.

Sources: ICE Data Services, Bloomberg Finance L.P., Office of Financial Research

default rates for firms rated BB. High-yield interest coverage ratios fell during the past two years but remain near the highs before the COVID-19 pandemic (**Figure 2-5**).

Outstanding balances for U.S. leveraged loans and loans made by private debt funds were almost \$3.6 trillion at year-end 2023, about three times as large as high-yield bond balances. Loans are far more likely than bonds to have floating interest rates, so higher interest rates since 2022 have increased borrowers' debt service costs and reduced interest coverage ratios. Default rates for all high-yield borrowers increased to more than 4% in 2023 from lower levels for most years since 2010. In 2024, the default rate has risen further.

Another development affecting risks of credit losses is changes in the language of leveraged loan contracts during the past decade. Previously, contracts restricted the borrower's ability to issue debt senior to existing debt and to move the firm's assets to subsidiaries beyond

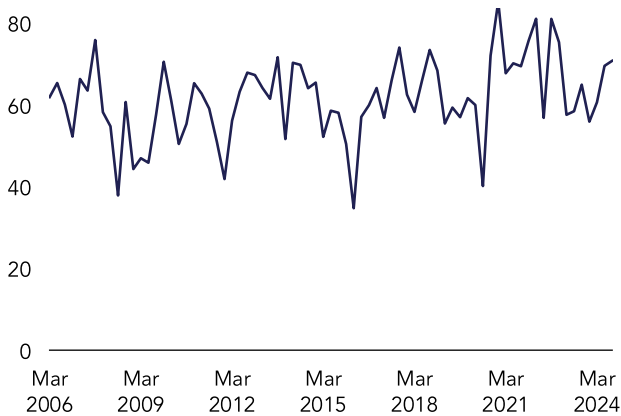
the reach of lenders. Many contracts now permit such actions. When taken, these actions can increase the firm's leverage and risk of default. In the event of default, these actions can reduce lenders' recoveries on defaulted loans.

Commercial Real Estate Debt

The amount of CRE debt outstanding was large at \$4.7 trillion as of Q2 2024. As discussed in the previous chapter, CRE includes a variety of property types in addition to office buildings, such as industrial, multifamily, retail, and hotels. Many CRE loans secured by office buildings continue to be distressed and at growing risk of default.

An important indicator of CRE default risk is the LTV ratio. This ratio is the outstanding mortgage balance divided by the current market value of the property and is a measure of leverage. Underwater loans, ones for which the mortgage balance is greater than the value of the property, are at particularly high risk of default.

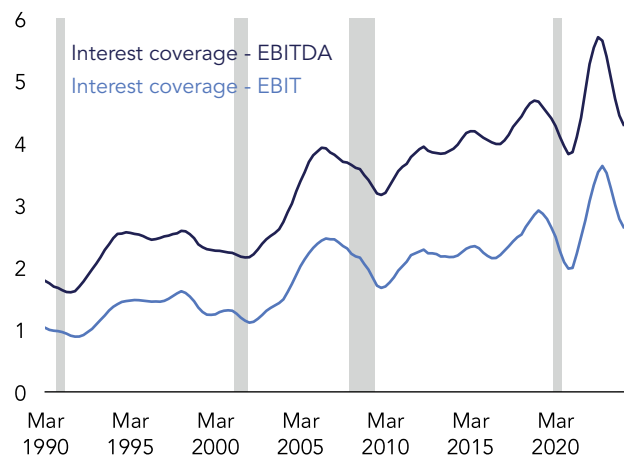
Figure 2-4. Share of Leveraged Loans and High-Yield Bonds Rated B or Lower (percent)



Note: Data as of September 30, 2024. The primary rating source is Moody's Ratings. Chart excludes loans and bonds that are not rated by S&P Global Ratings or Moody's Ratings.

Sources: PitchBook LCD, Office of Financial Research

Figure 2-5. High-Yield Interest Coverage Ratios



Note: Data as of June 30, 2024. Shaded areas are U.S. recessions (NBER). The interest coverage ratio is earnings before interest and taxes (EBIT) or earnings before interest, taxes, depreciation, and amortization (EBITDA), divided by interest expense. The data reflect companies with high-yield ratings from S&P Global Ratings.

Sources: Compustat, National Bureau of Economic Research, Office of Financial Research

Average LTV ratios for CRE loans for office buildings have been rising for several reasons. First, property values have been declining. Second, a surge in originations of new debt occurred in 2021 near the peak of CRE prices. Third, many CRE mortgages do not amortize, meaning that the borrower does not pay down the loan's principal balance over time.

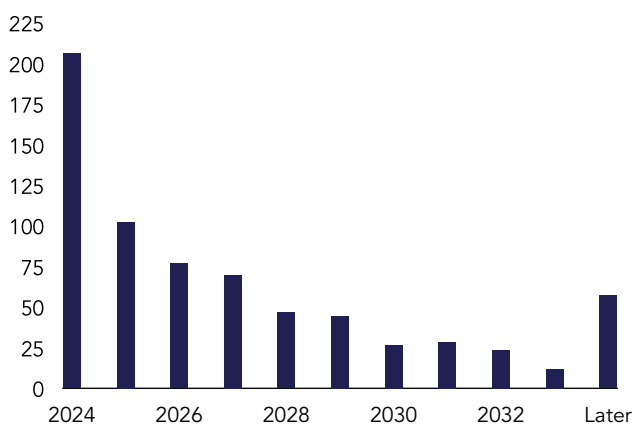
With rising LTV ratios, the owner's equity is falling. The amount of the owner's remaining equity depends on when the loan was originated. For loans originated several years before the COVID-19 pandemic, property values may have appreciated enough through 2021 so that the owner's equity remains positive even after recent property price declines. For loans originated closer to the 2021 peak, the owner's current equity is more likely to be negative because the LTV was high when prices started to decline.

CRE defaults on underwater loans tend to occur at loan maturity because borrowers may choose not to refinance or pay off their loans. Almost \$309 billion of office loans is expected to

mature by the end of 2025 (**Figure 2-6**). Many of these loans will be difficult to refinance. Along with the LTV ratio, another important metric for obtaining a mortgage is the debt service coverage ratio (DSCR), which is calculated as the property's net operating income divided by the mortgage payment. To refinance CRE debt, borrowers may need to provide evidence that their DSCR will be above 1.2 and to contribute new equity to bring the LTV ratio on their new loan below 75%. Even with additional equity capital, achieving a sufficiently high DSCR has become quite difficult in an environment of high interest rates, rising operating costs, and stagnating or declining rental income, especially for office properties.

Delinquency data by property type are available for CMBS. The overall CMBS delinquency rate was 5.7% in September 2024 (**Figure 2-7**). For office loans, the delinquency rate was 8.2%, a sharp year-over-year increase of 2.6%. Delinquency rates have been rising for most other property types as well, especially multifamily.

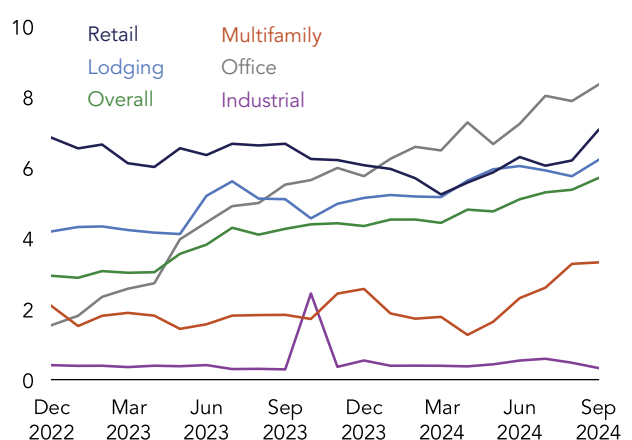
Figure 2-6. CRE Office Debt by Year of Maturity (\$ billions)



Note: Based on outstanding CRE mortgages as of Q4 2023.

Sources: Mortgage Bankers Association, Office of Financial Research

Figure 2-7. CMBS Delinquency Rates by Property Type (percent)



Note: Data as of September 30, 2024. Delinquency rates are for loans 30 days or more past due.

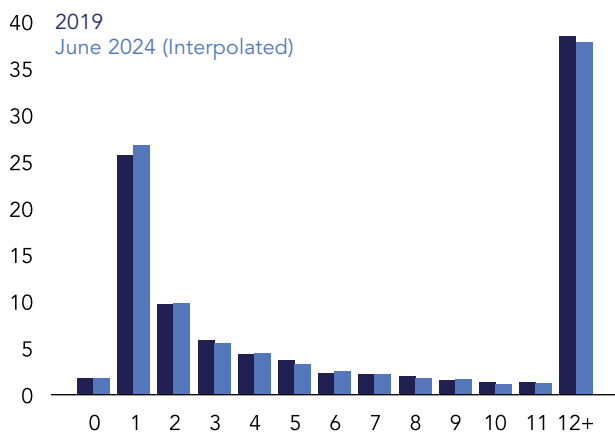
Sources: Trepp, Office of Financial Research

Household Borrowing

U.S. households had about \$21 trillion in debt outstanding as of Q2 2024. About two-thirds of this debt is from residential mortgages; the rest is a mix of auto loans, credit card debt, student loans, and other loan types. Rapid growth in household debt and leverage has been shown to be linked to the likelihood of financial crises.¹⁸

Overall, vulnerabilities associated with household debt remain at moderate levels. Most households are able to make their debt payments. However, based on a methodology developed by OFR researchers, 44% of households are estimated to have savings of at most three months of expenses (**Figure 2-8**).¹⁹ This finding is consistent with surveys that find a similar share of households having trouble paying their bills.²⁰ There is little or no indication of widespread distress in residential mortgage debt, partly because subprime mortgage lending is less widespread than before the 2007-09 financial crisis. Somewhat higher vulnerabilities are associated with nonmortgage

Figure 2-8. Projected Liquidity Conditions (percent of households)



Note: Months of liquidity has been collapsed into 13 bins based on the number of months a household can, at most, use their savings to cover expenses.

Sources: Bureau of Labor Statistics, Board of Governors of the Federal Reserve System, JPMorgan Chase Institute, Office of Financial Research

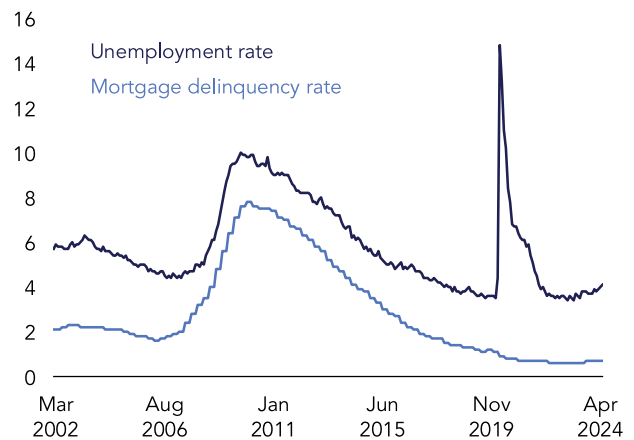
consumer debt because of increased credit risk associated with subprime borrowers, those with credit scores less than 620.

Household Mortgage Debt

As of Q2 2024, mortgage debt outstanding on 1- to 4-unit residences was about 45% of GDP, while total household debt was 71% of GDP. Vulnerabilities associated with households' mortgage debt currently are modest. Unemployment rates are low and supportive of households' ability to pay their debts, and only about 6% of outstanding mortgages as of Q2 2024 were to subprime borrowers. The delinquency rate on residential mortgages was 0.7%, well below the average of 3% since 2002 (**Figure 2-9**). The ratio of households' mortgage debt service payments to disposable personal income was also below its long-run average.

Rapid home price appreciation during the past four years has helped many homeowners build equity (**Figure 2-10**). More than 80% of active loans had a current, mark-to-market LTV ratio of

Figure 2-9. Mortgage Delinquency and Unemployment Rates (percent)



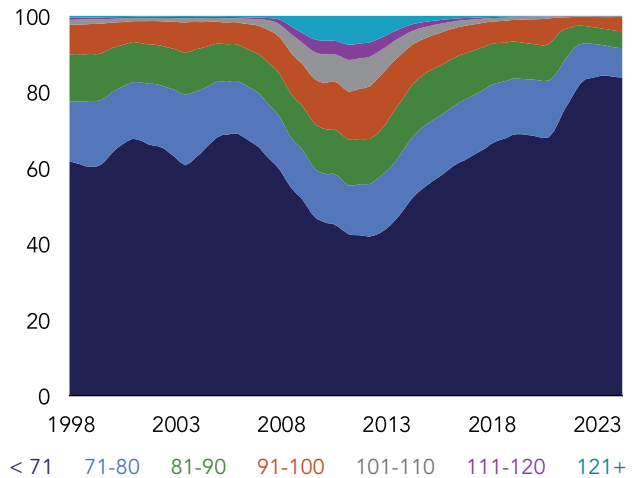
Note: Data as of June 30, 2024. Mortgage delinquency rate is for loans that are 90+ days delinquent plus loans that are in foreclosure, bankruptcy, or deed in lieu.

Sources: Bureau of Labor Statistics, Federal Reserve Bank of St. Louis FRED, Federal Housing Finance Agency National Mortgage Database, Office of Financial Research

less than 70% as of Q2 2024. Despite this, banks reported tightening their lending standards during 2023 and the first quarter of 2024 on all types of residential mortgages. Tighter standards have the potential to keep future delinquency rates low, even if the primary real estate market enters a period of stress.²¹

Other factors that affect home prices, however, may worsen household balance sheets and contribute to higher delinquency rates. For example, mortgages require property insurance. The price of insurance, where insurance is available, is rising rapidly, especially in areas experiencing adverse climate events.²² High insurance premiums may be contributing to home price declines in the most affected areas. The mix of soaring insurance premiums and falling house prices is a vulnerability for household balance sheets (see **The Uneven Distribution of Climate Risk in Residential Real Estate**). One study found that this is occurring even in states not typically thought to be at risk of climate-related losses.²³

Figure 2-10. Share of Mortgages by Current Mark-to-Market LTV (percent)



Note: Data as of May 31, 2024. LTV shares are calculated for all active loans.

Sources: Federal Housing Finance Agency National Mortgage Database, Office of Financial Research

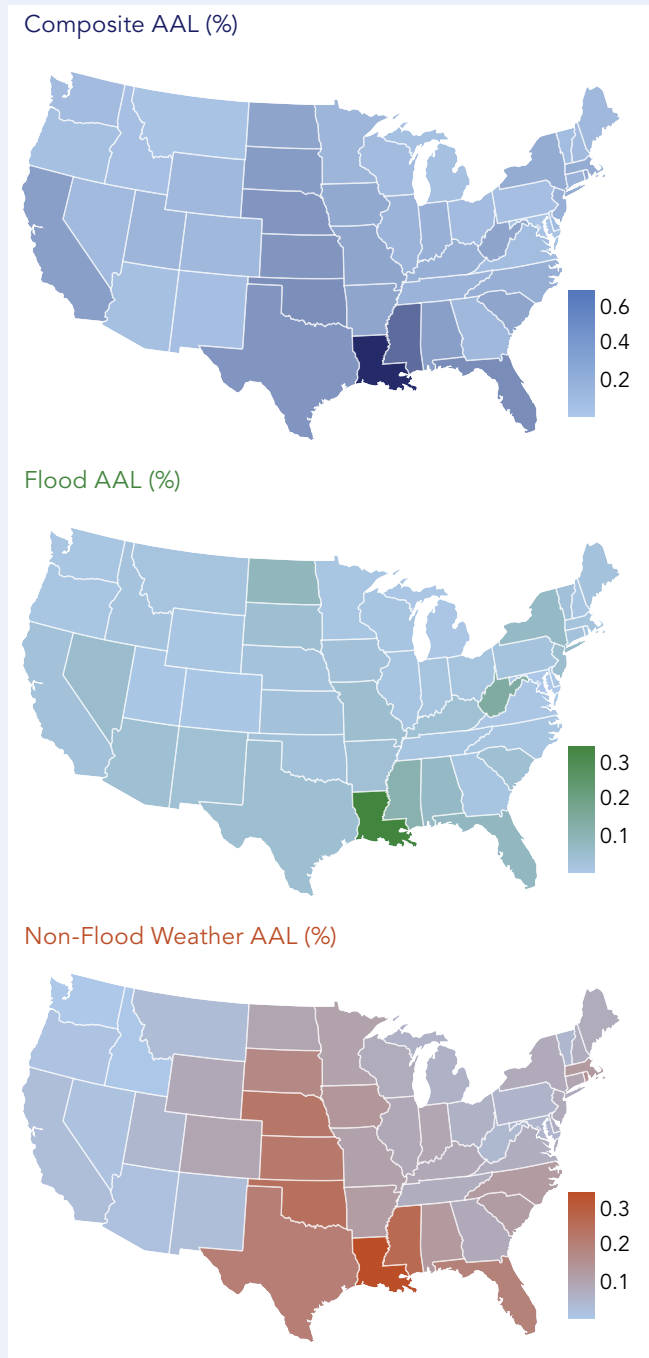
The Uneven Distribution of Climate Risk in Residential Real Estate

A large portion of household balance sheets and banks' loan portfolios are real estate and mortgage debt, where climate risks are a growing concern. Climate risks can devalue real estate because properties that are more susceptible to damage are less desirable to purchase and maintain. Such properties also have relatively higher insurance costs.

OFR researchers find that climate risks in real estate differ based on geography and demographics.²⁴ States vary in their risk of composite, flood, and non-flood property losses (**Figure 2-A**). Southeastern states, such as Louisiana, Florida, and Mississippi, have the highest composite risk because of elevated flood and non-flood weather risks. Coastal counties in these states have especially high flood risk. The researchers also find that counties with more vulnerable and less financially resilient residents tend to be more exposed to climate risk.

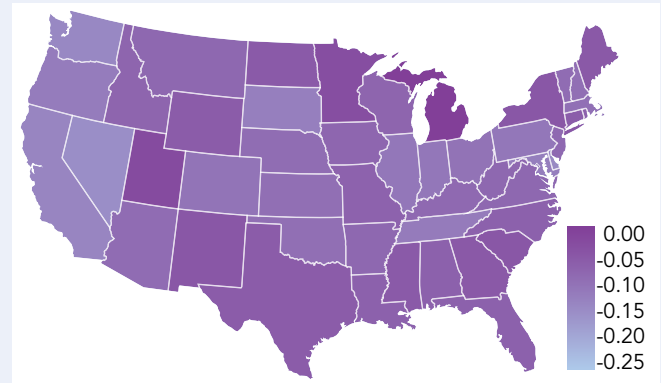
States vary in the sensitivity of home prices to climate risk (**Figure 2-B**). The researchers find that, on average, homes with higher climate risk tend to sell at lower prices. However, this sensitivity is not evenly distributed across demographics. In counties with older, less educated, and lower-income residents, home prices typically respond less to climate risk. Because home prices remain elevated despite climate risks in these regions, the more vulnerable segments of the population are effectively overpaying when they purchase a home.

Figure 2-A. Mean Average Annual Loss (AAL) by State and Type of Risk



Source: OFR Brief, "The Uneven Distribution of Climate Risks and Discounts" published February 29, 2024

Figure 2-B. Home Price Sensitivity to Climate Risk by State



Source: OFR Brief, "The Uneven Distribution of Climate Risks and Discounts" published February 29, 2024

The researchers estimate that the average homeowner stands to lose approximately \$11,000, or 4% of their home value and 34% of their home equity at the time of home purchase if prices change to reflect climate risk. By comparison, more vulnerable segments of the population face larger losses. For them, the average loss is equivalent to 6.1% of their home value and 61% of their home equity. Thus, a revaluing of real estate due to climate-related financial risks (CRFRs) can present a larger-than-expected shock to the financial system because the most likely group to be affected is also the least financially resilient.

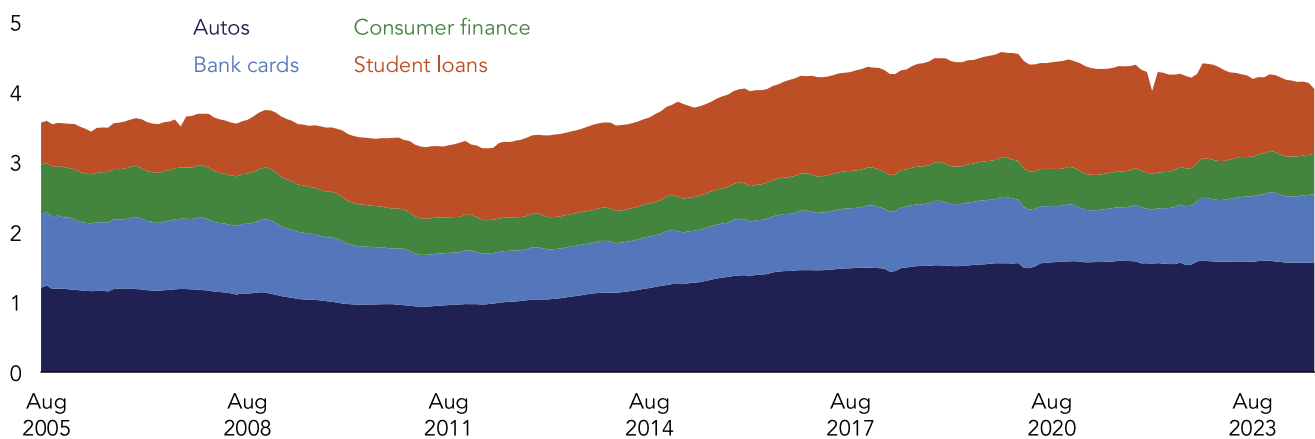
Nonmortgage Household Borrowing

Households also have debt in the form of auto loans, student loans, credit card loans, and other consumer loans. About \$4 trillion in debt of these types was outstanding in August 2024 (Figure 2-11).²⁵

Vulnerabilities associated with such debt are different for prime and subprime borrowers. Subprime borrowers' debt represents about

21% of all nonhousing debt, a share that has been relatively constant during the past 10 years. For the 12 months through August 2024, however, subprime balances grew 1.9%, while prime households' balances declined by 3%. Subprime borrowers typically have smaller savings and higher debt payments as a share of their incomes. This makes subprime borrowers especially vulnerable to declines in income or lost employment.

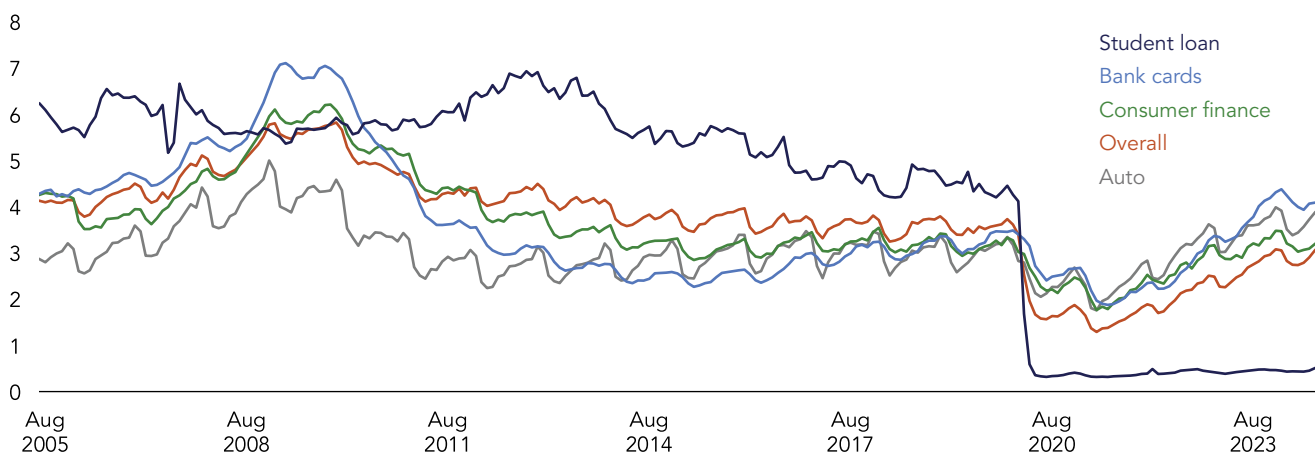
Figure 2-11. Aggregate Nonhousing Consumer Debt (\$ trillions)



Note: Data as of August 2024. Amounts are adjusted for inflation using the August 2024 Consumer Price Index.

Sources: Equifax, Bureau of Labor Statistics, Federal Reserve Bank of St. Louis FRED, Office of Financial Research

Figure 2-12. Nonhousing Delinquency Rate by Product Type (percent)



Note: Data as of August 2024. The overall nonhousing delinquency rate is the share of total debt balances on bank cards, autos, consumer finance loans, and student loans that are 30 or more days past due. These delinquency rates represent the noncurrent shares of consumers' aggregate debt balances.

Sources: Equifax, Office of Financial Research

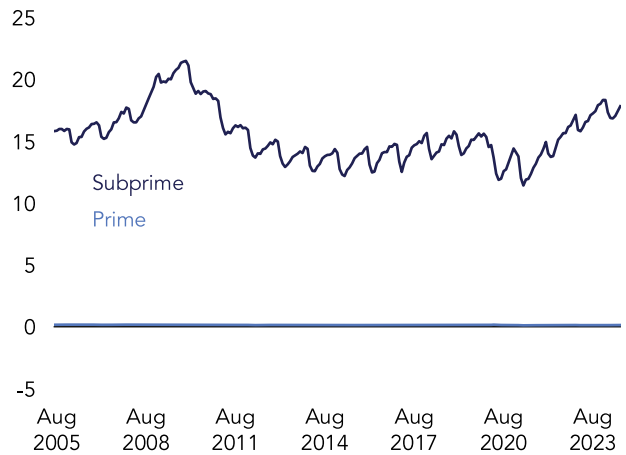
Delinquency rates for credit cards, autos, and other consumer loans increased during the past two years. This trend was driven primarily by subprime delinquencies. For auto and credit card debt, delinquency rates now exceed levels before the COVID-19 pandemic (**Figure 2-12**). Because subprime lending tends to be concentrated at a small number of financial institutions, a surge in subprime defaults may limit the ability of existing lenders to expand or maintain credit to subprime households.

In contrast to subprime households, prime households' delinquency rates remain near zero (**Figure 2-13**). The typical prime household has much more remaining debt capacity and higher savings relative to expenses than its subprime counterpart. For example, prime households' credit card balances are much smaller relative to their card limits (**Figure 2-14**).

In addition, homeownership rates are higher for prime borrowers. Large increases in home prices during the past five years, combined with low mortgage interest rates until 2022, have provided such households with lower mortgage payments and a reserve of home equity that can be drawn upon in bad times. Consistent with this, delinquency rates on nonhousing debt are lower for homeowners compared to non-homeowners (consumers who have never held a mortgage) (**Figure 2-15**). A large shock to incomes or credit availability would be required to degrade the provision of credit to prime households that are homeowners.

Vulnerabilities associated with student loans are an exception to the patterns described above. While delinquencies on other nonhousing debt are higher for student loan borrowers (**Figure 2-16**), student loan delinquencies and balances have been reduced in recent years by federal government forbearance and loan forgiveness policies, respectively, and have not returned

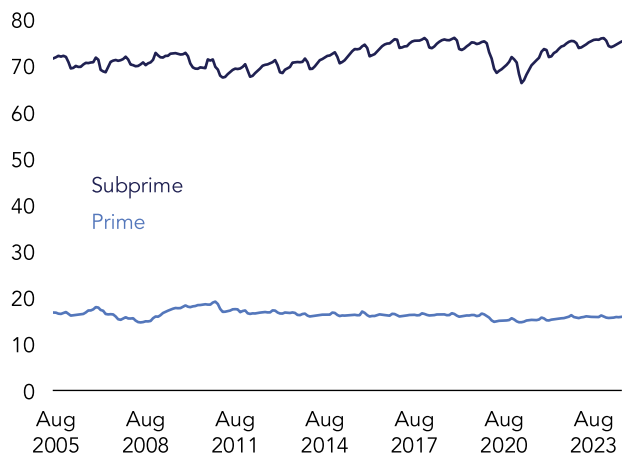
Figure 2-13. Nonhousing Delinquency Rate by Credit Score (percent)



Note: Data as of August 2024. The nonhousing delinquency rate is the share of total debt balances on bank cards, autos, and consumer finance loans that are 30 or more days past due. Student loans, mortgages, and home equity lines of credit are excluded. The delinquency rate for prime borrowers is near zero but not zero. Subprime consumers have credit scores below 620, and prime consumers have credit scores of 660 or greater.

Sources: Equifax, Office of Financial Research

Figure 2-14. Average Bank Card Utilization Rate by Credit Score (percent)

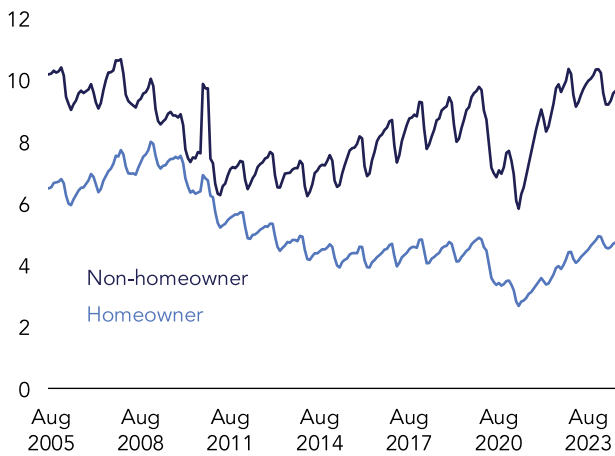


Note: Data as of August 2024. Subprime consumers have credit scores below 620, and prime consumers have credit scores of 660 or greater.

Sources: Equifax, Office of Financial Research

to previous levels. Missed federal student loan payments will not be reported to credit bureaus until Q4 2024.

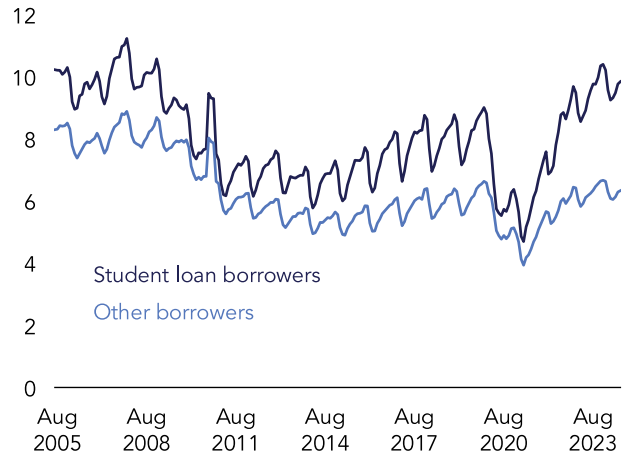
Figure 2-15. Nonhousing Consumer Delinquency Rates (percent)



Note: Data as of August 2024. Homeowners are defined as consumers who currently or previously had a mortgage, and non-homeowners are defined as consumers who have never had a mortgage. The nonhousing delinquency rate is the share of consumers who are 30 or more days past due on a bank card, auto, or consumer finance loan. Student loans, mortgages, and home equity lines of credit are excluded.

Sources: Equifax, Office of Financial Research

Figure 2-16. Nonhousing Delinquency Rate by Student Loan Borrowing Status (percent)



Note: Data as of August 2024. The nonhousing delinquency rate represents the share of consumers who are 30 or more days past due on a bank card, auto, or consumer finance loan. Student loans, mortgages, and home equity lines of credit are excluded.

Sources: Equifax, Office of Financial Research

The Household Financial Stress Measure

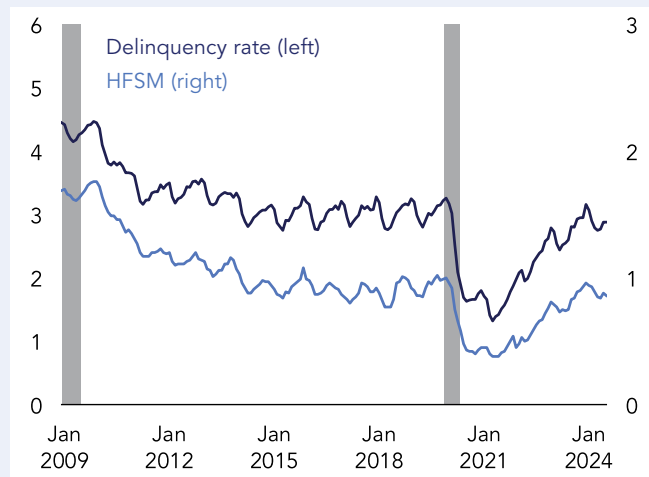
The COVID-19 pandemic and the associated inflationary pressures brought greater attention to the ability of households to withstand adverse shocks. Despite this, policymakers have lacked timely measures for monitoring household financial conditions. Traditional measures of household stress, such as leverage ratios and delinquency rates, capture stress associated with specific types of debt. These measures sometimes send inconsistent signals. For example, household leverage remains historically low. Yet, delinquency rates on nonmortgage consumer debt have steadily increased during the past two years and are currently somewhat elevated. This is in large part due to higher delinquency rates for subprime households.

To address the lack of timely data, OFR researchers developed a new measure that captures financial stress in the household sector. The Household Financial Stress Measure (HFSM) is based on the spread in delinquency rates between households that are more and less likely to experience stress due to financial factors (**Figure 2-C**).²⁶ Relevant financial factors include household leverage and access to credit. Intuitively, such characteristics can magnify the effect of deteriorating economic conditions on household balance sheets. The spread captures the degree of stress that households experience as a result. Higher unemployment should be felt more acutely in households with high leverage, for example.

The HFSM indicates that household financial stress was elevated late in the 2007-09 financial crisis and declined during the ensuing decade. Mirroring these patterns, aggregate household leverage

fell to historically low levels during the same period. During the COVID-19 pandemic, the HFSM fell to its lowest level since 2009. Sizable government transfers significantly helped buttress household liquidity positions. These transfers included multiple rounds of Economic Impact Payments, enhanced unemployment benefits, and public loan forbearance. When these transfers began to sunset, the spread rapidly rose. As of May 2024, the HFSM had largely reverted to levels before the pandemic but below its 2009 peak. This suggests that lower financial stress may have reduced vulnerabilities by better positioning households for adverse events. Higher realized delinquency rates correspond with higher predicted delinquencies from financial stress (**Figure 2-D**).

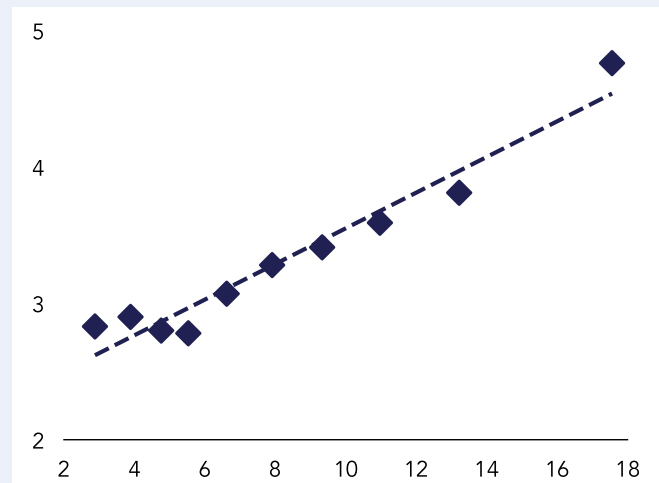
Figure 2-C. Measures of Household Financial Stress (percent)



Note: Data as of August 31, 2024. Shaded areas are U.S. recessions (NBER).

Sources: Equifax, National Bureau of Economic Research, Office of Financial Research

Figure 2-D. Predicted Versus Realized Delinquency Rates (percent)



Note: Data as of August 31, 2024. Counties are grouped into deciles based on predicted delinquency rates. The x-axis corresponds to the mean predicted value within a decile. The y-axis shows the average realized delinquency rate for each decile. A trendline is included to highlight the positive, linear correlation between the predicted and realized values.

Sources: Equifax, Office of Financial Research

Technology

Technology is integral to nonfinancial businesses and households. Businesses are exposed to technology vulnerabilities from their own use of technology and through their TSPs. Some TSPs serve many businesses within or across economic sectors. The TSPs' market dominance often becomes clear only when their operations are disrupted and their customers' finances are strained. Households are exposed to technology risk through the businesses with which they transact

and indirectly through the vendors used by those businesses. The effect on households is primarily through fraud facilitated by data breaches. While the costs to households can be large, the bulk of the costs falls on financial institutions, so this vulnerability is discussed in the next chapter.

For businesses, the growth in cyberattacks at dominant service providers has highlighted their exposure to technology. Almost a third of cybersecurity breaches discovered in Q4 2023 occurred through an attack on a TSP.²⁷

The 2024 cyberattack on Change Healthcare (Change) illustrates how a cyber event that disrupts the business sector can transmit stress to the financial system.

Change took its operations offline on February 21, 2024, after a ransomware attack. Change has a very large presence in the U.S. healthcare sector. Its technology enables more than 100 critical functions for healthcare providers. One function includes operating a claims and payments clearinghouse for about 189,000 medical providers. Change processes \$2 trillion in annual claims, covering 44% of all funds flowing through the medical system, or about 7% of GDP.²⁸ Its market share and the wide range of business functions that its technology enables make Change a critical component of and single point of failure for the healthcare sector (**Figure 2-17**), as the cyberattack demonstrated.

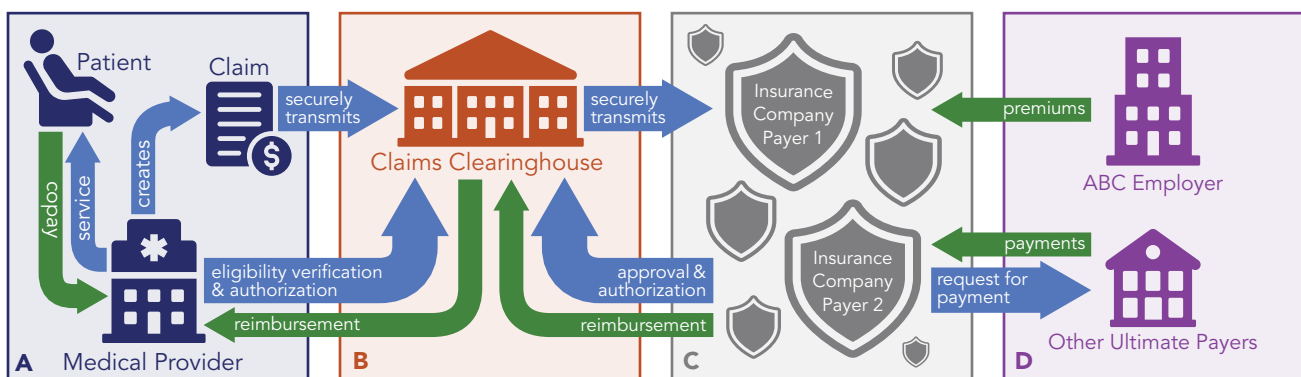
The attack halted Change’s operations and many of the back-office functions on which the healthcare sector relies. With Change’s clearinghouse offline, healthcare providers were largely unable to process claims and

receive payments for their services. This, in turn, caused cash flow problems for healthcare businesses as they struggled to pay operating expenses and debt. An American Medical Association survey of physician practices found that a majority relied on personal funds to cover practice expenses, while others considered bankruptcy.²⁹ At the end of August, Change and its customers were still addressing the fallout from the cyberattack.³⁰

Healthcare providers, like businesses in many other industries, tend to have little resilience to a cyberattack or other disruption at a TSP that provides the specialized technology they need in one bundle. Bundled technology solutions have the advantage of working well together. The bundles are costly, however, and competing TSP bundles are rarely interoperable. This forces businesses to choose which TSP will be their sole provider and forego having access to a backup provider.

Switching TSPs, especially during a service disruption, is costly and may be impossible. A business would have to research vendors,

Figure 2-17. Role of Claims Clearinghouse



Note: A) Before receiving services, patients present their insurance cards, and the medical provider verifies the coverage. Most providers use medical billing software to generate e-claims that must be securely transmitted. B) The claims clearinghouse scrubs the claim and checks for errors, reducing the error rate to 2-3% from 28% for paper claims. The clearinghouse maintains secure connections to insurance company payers, and they use those connections to check eligibility and forward the claims. The clearinghouse transfers reimbursements to medical providers from the insurance companies. C) Insurers verify eligibility, approve or reject claims, and reimburse medical providers through the clearinghouse. D) Employers pay premiums to insurance companies. In some cases, employers self-insure and are the ultimate payer.

Source: Office of Financial Research

negotiate prices, and transition operations—assuming that it can break its contract with its current TSP. If the TSP is large, competing TSPs with smaller market share might not be able to scale quickly enough to absorb the new business coming their way.

Given the healthcare sector's size, Change's role, and the duration of the service outage, the cyberattack had the potential to spread stress to the financial sector. Extensive and less automated workarounds by healthcare businesses mitigated the stress. The federal government reduced the risk of spillovers by advancing funds toward delayed medical payments. That is, the government, acting through the Centers for Medicare & Medicaid Services, injected liquidity into the healthcare sector, much as the Federal Reserve does for the financial system in times of stress. Because the Change outage created a liquidity event, it counts as a financial instability near miss. It can serve as a useful warning on the need for all businesses to ensure that their operations can withstand a technology disruption.

3. Financial Institutions

Financial institutions provide a wide array of financial services to the economy. Many of them are conglomerates incorporating several of the types of financial institutions discussed in this chapter. Some conglomerates are popularly categorized as asset managers, while others are insurance companies or banks.

Financial institution insolvency and failure, or inability to provide financial services, can disrupt financial stability directly or by causing stress at other financial institutions. Their vulnerabilities are associated with excess leverage, insufficient liquidity, or elevated portfolio risk. Any of these conditions can exacerbate the risk of failure. Leverage is influenced by a financial institution's equity capital. Portfolio risk is determined by the mix of the institution's assets. Insolvency occurs when losses are large enough to eliminate a financial institution's equity. Liquidity, which is a financial institution's ability to rapidly pay claimants, is influenced by the share of assets that can be readily converted to cash without material loss.

Sometimes, either solvency or liquidity is such a dominant driver of an episode of financial instability that the circumstances can aptly be described as related only to solvency or only to liquidity. Frequently, the two are almost inseparable. The typical run on a bank is an example. Whether a run is initiated by depositor concerns about solvency, liquidity, or something else, once it starts, concerns about both solvency and liquidity play a role. Liquidity matters because a run rapidly depletes a bank's liquid assets and ability to immediately borrow funds. Solvency matters because once liquidity is impaired, a bank might need to sell illiquid assets at a substantial discount, driving it further toward insolvency.

Vulnerabilities vary across the types of financial institutions and across institutions within types. For banks overall, vulnerabilities appear low. Banks' loan books appear healthy except for CRE loans against office buildings. Life insurers' insolvency and liquidity risk has been increasing. While their leverage has remained fairly stable for many years, the credit and liquidity risk associated with their assets has grown. Hedge funds' leverage has continued to trend up as their borrowing has risen sharply, especially from prime brokers and through repos. New types of private lenders, particularly those associated with private equity funds, have grown rapidly, but data on their leverage and portfolio risk are limited. Some open-end bond mutual funds remain vulnerable to large withdrawals by their investors. The funds may not be able to meet such withdrawals if they are heavily invested in less liquid assets. Bank lending to NBFIs remains sizable and exposes banks and the broader financial system to stress originating at NBFIs. A series of cyberattacks on financial institutions and their TSPs disrupted operations at these and other entities, highlighting the potential for technology vulnerabilities to impair financial stability.

Banks

Banks are major suppliers of credit to the economy. Bank deposits serve as cash-like instruments and short-term investments for households and many businesses. Banks provide other financial services as well, such as brokerage and investment banking, payment services, and asset management (see **The Transformative Ways in Which Banks Add Value**). If a bank fails, until the bank is sold or liquidated, the provision of new loans would

The Transformative Ways in Which Banks Add Value

Banks, in carrying out their basic functions, engage in maturity and liquidity transformation, both of which have benefits but also bring risks.

Maturity Transformation

A defining function of banks is maturity transformation, in which banks invest in long-term assets, such as loans and Treasury bonds, financed by short-term liabilities like demand deposits. This function supplies bank customers with long-term credit, such as business loans and home mortgages. It also exposes banks to the risk of borrower defaults, as well as interest rate risk when assets or liabilities have fixed interest rates. Interest rate risk is the danger that losses may be incurred when interest rates change. For example, the increase in interest rates in 2022 caused banks to suffer substantial losses in the market value of their long-term fixed-rate securities. One way to mitigate interest rate risk is by using derivatives, although recent research has called into question the extent to which banks have engaged in such hedging.³¹ There are other ways to mitigate interest rate risk as well.

Liquidity Transformation

In liquidity transformation, banks create highly liquid liabilities like demand deposits and use them to fund holdings of illiquid assets, such as loans. This function satisfies investor demand for money-like assets. However, it leaves banks vulnerable to runs. Depositors may rush to withdraw their money from a bank when they become concerned about the possibility of the bank's failure. The rapid collapse of SVB from depositor runs in March 2023 is a case in point. Banks can mitigate run risk by reducing their reliance on uninsured deposits and other runnable sources of funding.

stop immediately, but some of its banking services would continue to be provided.

Banks are always vulnerable to a deterioration of the credit quality of their loans and other assets. Currently, the credit quality of most banks' loans and other assets appears relatively healthy, except for certain CRE loans that finance office buildings. Banks are also always vulnerable to rapid outflows of deposits, especially uninsured deposits, and other liabilities. However, after the outflows that followed the failure of three regional banks in 2023, deposits have remained stable overall.

Capital

Sufficient equity capital is a key resource for preserving bank solvency. Historically, most bank failures were caused by loan losses larger than the sum of a bank's capital and loan loss reserves. One measure of bank capital, the aggregate equity-to-asset ratio, decreased from 11.1% at year-end 2014 to 9.8% at year-end 2023. Bank capital requirements may change once the federal banking agencies issue their final rule on regulatory capital requirements for large banking organizations.³²

Stress tests conducted by the Federal Reserve assess the risks borne by large banks relative to their capital. The 2024 results show that all tested banks would remain solvent in a scenario with severe credit losses and large

losses in the trading book. In addition, the capital of each participating bank would remain above regulatory minimums. For example, the Tier 1 leverage ratio for all participating banks would fall from 7.8% to 6.2%, well above the minimum of 4%. The Tier 1 leverage ratio of Goldman Sachs, the U.S.-headquartered bank most affected by the severely adverse scenario, would fall to 4.5%.

Liquidity

A key contributor to liquidity risk for banks is their uninsured deposits—deposits exceeding the FDIC insurance-coverage limit of \$250,000. These deposits are particularly vulnerable to rapid withdrawal because their holders fear that they may suffer losses if their bank fails. The extent of the vulnerability is not fully known, in part because of gaps in banks’ disclosure of uninsured deposits (see **Data Gaps Regarding Banks’ Uninsured Deposits**).³³

Data Gaps Regarding Banks’ Uninsured Deposits

Heavy reliance on uninsured deposits was a significant contributor to the rapid collapse of SVB and Signature Bank in March 2023. At year-end 2022, at least 89% of deposits at the two banks were uninsured. At First Republic Bank, which failed two months later, 67% of deposits were uninsured. These bank failures led to significant regulatory intervention to reduce the risk of runs spreading more widely. Since that time, there has been broad scrutiny of banks’ uninsured deposit levels and reporting.

Financial institutions with a large share of uninsured deposits are more likely to experience runs when there is concern about their financial condition. Currently, however, only those institutions

Figure 3-A. Uninsured Deposit Information Reporting Requirements

Institution Type	Uninsured Deposit Information Reported	Regulatory Filing	Number of Institutions	Percent of Institutions	Reporting Frequency of Uninsured Deposit Information	Availability
FDIC-Insured Institutions with Total Assets < \$1 Billion	None	Call Reports*	3,618	79% of the 4,594 Call Report filers	N/A	N/A
FDIC-Insured Institutions with Total Assets ≥ \$1 Billion	Estimated uninsured deposit balances	Call Reports	976	21% of the 4,594 Call Report filers	Quarterly	Publicly available
BHCs or SLHCs with Total Assets < \$100 Billion	None	FR Y-9C**	345	91% of the 381 FR Y-9C filers	N/A	N/A
Top-Tier BHCs or SLHCs with Total Assets ≥ \$100 Billion	Estimated uninsured deposit balances from FR 2052a	FR 2052a***, FR Y-9C	36	9% of the 381 FR Y-9C filers	Daily or monthly from FR 2052a, depending on bank categories	Supervisory, confidential (not publicly available)

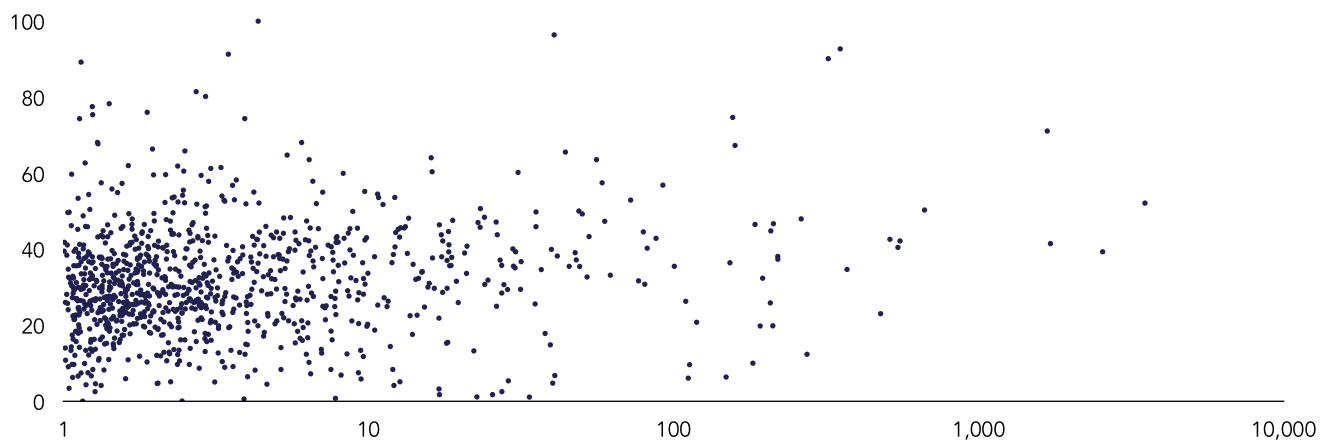
Note: Data as of quarter-end Q2 2024. Institutions include commercial banks, thrifts, and savings banks. BHC = bank holding company. SLHC = savings and loan holding company. SEC = Securities and Exchange Commission. *Publicly traded banks are required to disclose uninsured deposits in SEC filings. A small fraction of the banks in this size category must do so. **BHCs with less than \$3 billion in assets are generally not required to file the FR Y-9C. ***Some material subsidiaries of these holding companies also file the FR 2052a.

Sources: Federal Financial Institutions Examination Council, Board of Governors of the Federal Reserve System, Office of Financial Research

with more than \$1 billion in assets are required to report uninsured deposit information. As a result, information about uninsured deposits is either unavailable or not publicly available for most institutions (**Figure 3-A**).

Some financial institutions that report uninsured deposit information rely heavily on these deposits (**Figure 3-B**). Any institution with high reliance on uninsured deposits can quickly collapse from deposit runs. This makes the scarcity of uninsured deposit information a financial stability vulnerability. Data on uninsured deposits are a key input to any assessment of an institution's run risk. Closing the data gaps would allow regulators and market participants to better monitor and evaluate run risk.

Figure 3-B. Uninsured Deposits (percent) Across Financial Institutions of Different Asset Sizes (\$ billions, log scale)



Note: Data as of June 30, 2024. The data are for the 976 FDIC-insured financial institutions with \$1 billion or more in assets that reported estimated uninsured deposits in Call Reports.

Sources: Federal Financial Institutions Examination Council, Office of Financial Research

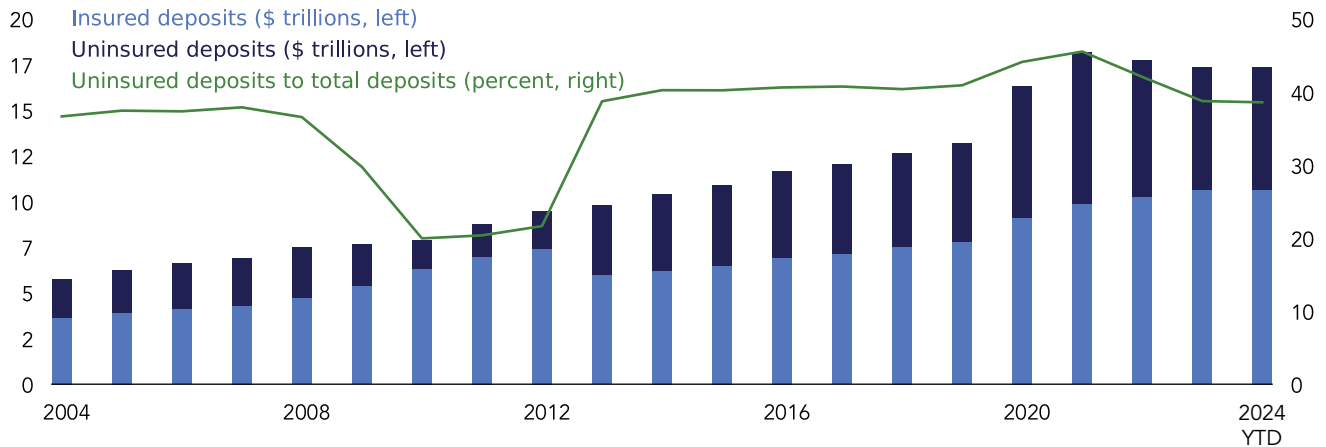
Increasing the reporting frequency to monthly for financial institutions that already disclose their uninsured deposits would more promptly show when vulnerabilities are building. Institutions should already be monitoring their uninsured deposits, reducing the burden of more frequent reporting.

Some additional data elements would make the current reports more valuable. Data on deposit concentrations would identify institutions that rely heavily on a few large depositors or deposits from a few sectors. Data on uninsured deposits by counterparty type, such as retail, small business, and corporate, as well as by account type (transactional or operational account), would shed light on sources of run risk.

Expanding the number of financial institutions reporting at least uninsured deposit levels would improve visibility into the funding structure and stability of more banks. In choosing the asset size above which institutions must report, the benefits of this additional information would need to be weighed against the costs of reporting.

On August 6, 2024, the FDIC published a Request for Information on Deposits that solicited comments from interested parties about deposit data that are not currently reported. Among other things, the request sought comments on uninsured deposits, the composition of deposits, and the stability of different kinds of deposits.³⁴

Figure 3-1. Uninsured and Insured Deposits and Ratio of Uninsured Deposits to Total Deposits



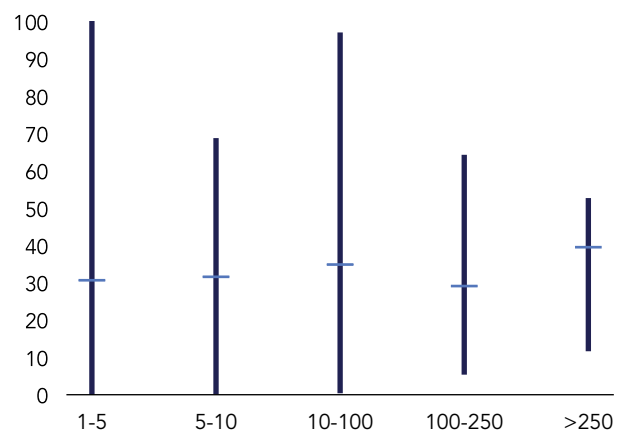
Note: Data are for all FDIC-insured financial institutions from the FDIC Quarterly Banking Profile as of June 30, 2024. Uninsured and insured deposits are estimates, and their sum is total deposits.

Sources: Federal Deposit Insurance Corporation, Office of Financial Research

Since the 2023 banking turmoil, banks have increasingly used reciprocal deposits as a tool to expand FDIC insurance coverage and to reduce liquidity risk from runs. Through third-party reciprocal deposit network sponsors, such as IntraFi and others, banks swap customer deposits with one another to keep the amount in each account at or below \$250,000. This makes it possible for a bank customer to hold tens of millions of dollars in insured accounts with a single relationship bank. Total reciprocal deposits increased from \$157 billion at year-end 2022 to \$363 billion a year later.

Total deposits have changed little since the Federal Reserve began raising short-term interest rates in 2022 (**Figure 3-1**). Some depositors moved money into money market mutual funds (MMMFs) or other instruments that pay market rates of interest. However, the fraction of all deposits estimated to be uninsured has been fairly stable for many years.

Figure 3-2. High, Average, and Low Share of Uninsured Deposits (percent) by Bank Asset Size (\$ billions)



Note: Data as of June 30, 2024. The x-axis represents bank asset size ranges in billions of dollars. Data are for the 976 FDIC-insured financial institutions with \$1 billion or more in assets that reported estimated uninsured deposits in Call Reports.

Sources: Federal Financial Institutions Examination Council, Office of Financial Research

That fraction varies widely across individual banks (**Figure 3-2**). A bank can be prepared for large withdrawals of deposits by posting collateral at backstop wholesale lenders like the Federal Reserve and Federal Home Loan Banks (FHLBs), but a sufficiently large and speedy run usually leads to bank failure.

Interest Rate Risk

Following the bank distress in early 2023, attention focused on the large number of banks with unrealized losses on their securities holdings. However, the effect of changes in interest rates on bank solvency requires looking at both bank liabilities and assets.

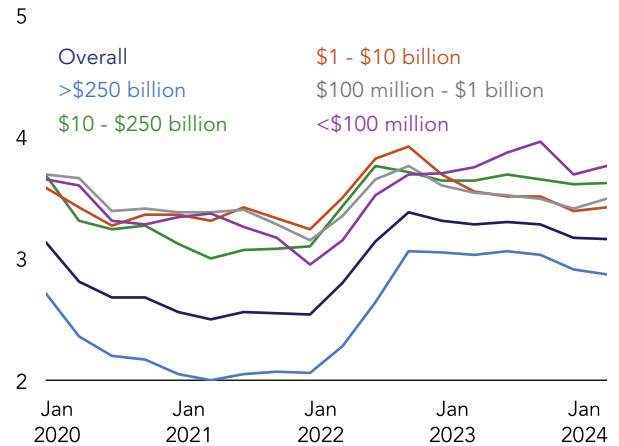
One way that a bank can reduce its risk of insolvency is by managing its assets and liabilities so that interest rate changes have little net effect when both sides of its balance sheet are considered. For example, when interest rates increase, the value of fixed-rate securities and loans falls. At the same time, the value of deposits increases because many depositors tolerate receiving lower interest rates for a period. A bank's income and solvency can remain stable if the maturity profile of its fixed-rate assets, which influences the assets' interest rate sensitivity, is compatible with the interest sensitivity of its deposit costs.

A bank's net interest margin (NIM) can be used to assess the net effect of changes in interest rates on both assets and liabilities. The NIM is the difference between the interest received on assets and that paid on liabilities expressed as a percentage of assets. A bank that has managed its balance sheet to protect solvency when interest rates change is likely to have a NIM that remains fairly stable. The NIM for banks in the aggregate has increased since short-term interest rates began rising but is down slightly from last year (**Figure 3-3**).

Higher NIMs are associated with a healthier banking system and may offset realized losses in other parts of the banking business.

The change in NIM from year-end 2021 to year-end 2023, plotted against the weighted-average life of the securities portfolio at year-

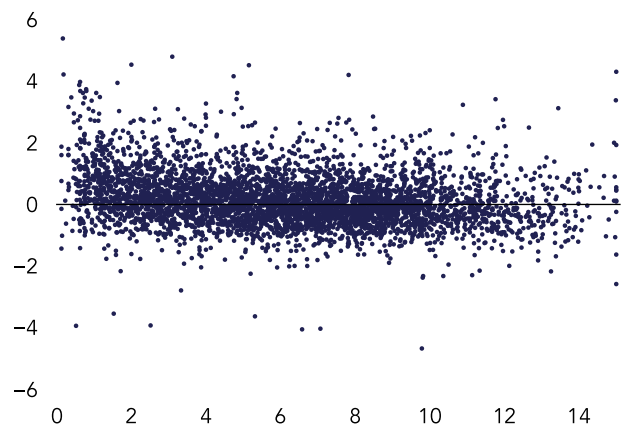
Figure 3-3. Net Interest Margin (percent) by Bank Asset Size



Note: Data as of June 30, 2024.

Sources: Federal Deposit Insurance Corporation, Office of Financial Research

Figure 3-4. Change in Net Interest Margin (percent) Across Weighted-Average Life of Securities Portfolio (years)



Note: Data as of June 30, 2024. The x-axis is the weighted-average life of the securities portfolio measured in years. The change in net interest margin is measured from December 31, 2021, to June 30, 2024. The figure is based on all 4,594 FDIC-insured financial institutions.

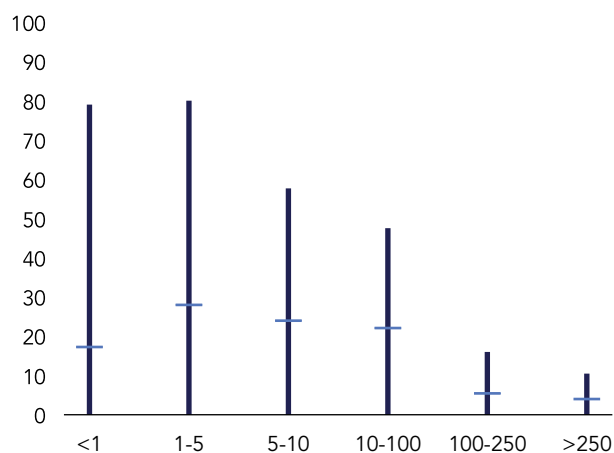
Sources: Federal Financial Institutions Examination Council, Office of Financial Research

end 2021 for all banks, gives a sense of the share that might not have been positioned for interest rate changes (**Figure 3-4**). The plot is consistent with the increase in interest rates since 2022 having only a modest impact on the income and solvency of the vast majority of banks. Banks near the bottom-right corner of the scatterplot were more vulnerable; the value of their fixed-rate assets fell more than that at banks with shorter-maturity securities holdings. This is because changing interest rates have larger effects on the value of longer-term securities. Their NIMs also fell significantly, implying that the value of their deposits did not increase by an offsetting amount. Few banks appear in that part of the scatterplot. For example, only 56 banks, with \$79 billion of assets, have a securities portfolio weighted-average life of 10 years or longer and a decline in their NIM of 1% or more.

Credit Risk

The overall quality of banks' outstanding loans remains sound, although the risk associated with CRE loans has increased (see **The Impact of Commercial Real Estate on Bank Balance Sheets**). The largest banks have a relatively small fraction of assets in CRE loans; smaller banks' exposure to CRE loans varies widely (**Figure 3-5**). The CRE loan data include loans for apartment buildings, industrial facilities, warehouses, and other types of CRE, as well as office buildings.

Figure 3-5. High, Average, and Low CRE Loans-to-Assets Ratio (percent) by Bank Size (\$ billions)



Note: Data as of June 30, 2024. The x-axis shows bank size in billions of dollars. Data are for 4,594 FDIC-insured financial institutions. Construction and land development loans other than 1- to 4-unit residential are included in the data shown.

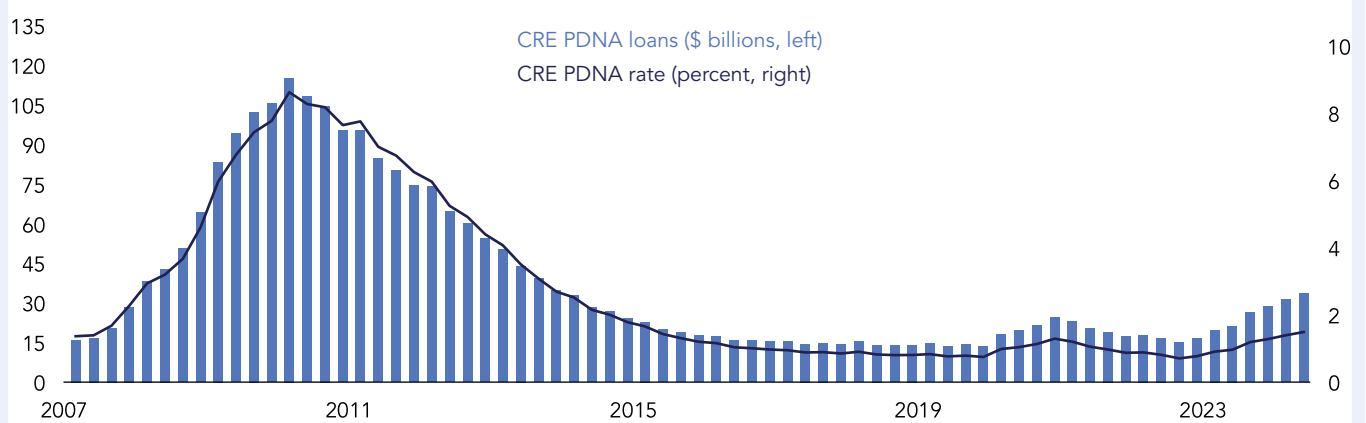
Sources: Federal Financial Institutions Examination Council, Office of Financial Research

Among CRE loans, risk has increased most for loans secured by office buildings. Small- to medium-size owner-occupied office buildings likely pose less credit risk, and loans on larger, lower-quality office buildings in downtown areas likely pose the highest risk. The limited number of arm's length office-building transactions that have occurred recently makes assessing the future performance of CRE office loans more difficult. Data about the mix of types of office loans are limited except for the largest banks.

The Impact of Commercial Real Estate on Bank Balance Sheets

Banks continue to be the largest holders of CRE debt, exposing them to potentially large credit losses if defaults increase significantly. The past due and nonaccrual (PDNA) rate (**Figure 3-C**) has been increasing since mid-2022. As of Q2 2024, bank CRE loans had a PDNA rate of 1.5%, which, while manageable, is the highest level since Q1 2015. The increase was driven by the office loan portfolios at the largest banks. Net charge-offs lag increases in PDNA loans because the distressed-loan workout process can take years.

Figure 3-C. Bank CRE PDNA Loans and PDNA Rate



Note: Data as of June 30, 2024. The chart represents past due and nonaccrual (PDNA) loans for all 4,594 FDIC-insured financial institutions.

Sources: Federal Financial Institutions Examination Council, Office of Financial Research

During a CRE downturn, losses can be severe. For example, following the 2007-09 financial crisis, the net charge-off rate did not peak until the end of 2011 even though the PDNA rate peaked in 2010.

Much uncertainty exists about CRE loan losses going forward. However, a rough gauge of their likely impact on bank solvency can be obtained from a scenario analysis that applies a range of charge-off rates to all CRE loans on banks' balance sheets (**Figure 3-D**). The charge-off rate would have to exceed 25% at each bank, far worse than the 2011 peak of 7.3%, for more than a few hundred banks to become insolvent. Any other losses on bank balance sheets are excluded from the analysis. The analysis is conservative because potentially distressed office loans are likely only a modest fraction of CRE loans at most banks.

Figure 3-D. Number of Insolvent Banks for Different CRE Charge-Off Rates, Q4 2023

CRE Loan Loss Rate	Number of Insolvent Banks	Assets (\$ billions)	CRE Loans (\$ billions)	CRE Loans/Assets (percent)
Below 10%	20	11	1	12
10% to 15%	24	21	8	40
15% to 20%	146	165	74	45
20% to 25%	346	444	172	39
25%+	4,058	23,264	1,997	9
Total	4,594	23,906	2,254	9

Note: Data as of June 30, 2024, for all FDIC-insured financial institutions.

Sources: Federal Financial Institutions Examination Council, Office of Financial Research

Significant CRE loan concentrations are generally limited to smaller banks, so future CRE loan losses alone are likely not a threat to banking system solvency. However, uncertainty about the resilience of banks to CRE loan losses could cause a loss of confidence in financially vulnerable banks. On December 18, 2023, the FDIC issued a Financial Institution Letter emphasizing the importance of strong capital, appropriate credit loss allowance levels, and robust credit risk management for banks with CRE concentrations.³⁵

Climate-Related Financial Risk

Uncertainty remains about banks' exposure to progressively more severe climate events. While the growing frequency of these events exposes banks to increasingly large physical risks, data challenges make a full assessment difficult.

There is mixed evidence about the effects of CRFR on bank performance. OFR researchers find significant variation across the largest banks in how their internal risk models capture CRFRs.³⁶ In terms of physical risk, a study from the Federal Reserve Bank of Philadelphia shows that past extreme storms imposed significant losses on U.S. banks.³⁷ In contrast, a study from the Federal Reserve Bank of New York (FRBNY) shows insignificant or small effects of Federal Emergency Management Agency (FEMA) disasters during the past century on U.S. bank performance.³⁸ A separate study from the FRBNY suggests that U.S. banks are exposed to modest levels of climate-related transition risks.³⁹

Insurance Companies

Insurance companies play a prominent role in the financial system due to their large investment portfolios. Insurers' cash and invested assets totaled \$8.5 trillion at the end of 2023. Additionally, insurers provide financial compensation to businesses and households that experience covered losses.

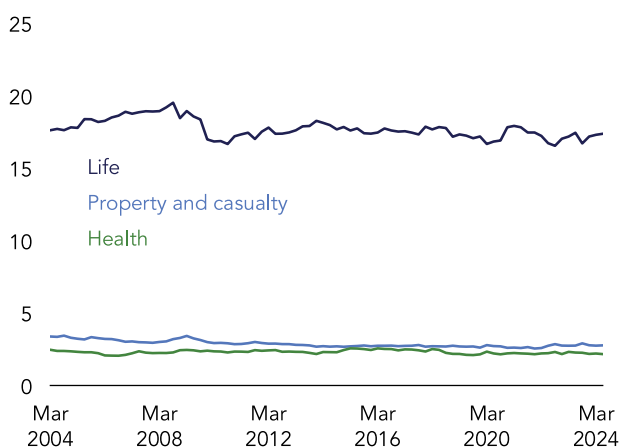
Life Insurers

The most important current life insurer vulnerabilities are associated with credit and liquidity risk. Life insurance companies provide annuities and other products, such as long-term care and disability insurance, in addition to life insurance. A growing number also assume obligations from corporate pension plan sponsors. Life insurers are vulnerable to interest rate and credit risk affecting their investment returns and to mortality, morbidity, longevity, and other risks associated with the policies they issue. Realized credit losses have been the cause of most life insurer failures historically.

Although most of their liabilities appear to be long-term, some life insurance company liabilities have surrender or borrowing provisions that require insurers to remit requested funds to policyholders or other liability holders. These features mean that life insurers can be subject to the risk of a rapid withdrawal of liabilities. Moreover, most life insurance companies have cash and short-term assets that are a modest fraction of total assets. A sufficiently rapid and unexpected withdrawal during periods of stress at the institution or in financial markets could lead to a fire sale of assets, with an associated effect on market prices and volatility. Insurers utilize surrender charges and other withdrawal penalties to limit incentives to withdraw. These measures may be insufficient when concerns about an insurance company's soundness are acute.

Life insurer leverage has changed little over time (**Figure 3-6**). Measured as the ratio of general account assets to policyholder surplus, leverage at life insurers remains consistently higher than that of property and casualty (P&C) or health insurers. Policyholder surplus is similar to insurer equity capital, and data on it are available for all insurers, including mutual insurance companies, which is not the case with some other measures of equity capital.

Figure 3-6. U.S. Insurers' Leverage (ratio)



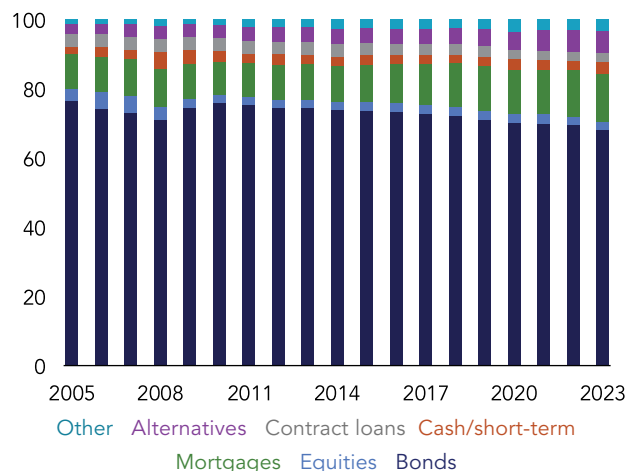
Note: Data as of June 30, 2024. Leverage is the ratio of assets to policyholder surplus, which is the difference between an insurer's assets and its liabilities.

Sources: S&P Capital IQ Pro, Office of Financial Research

As at banks, insolvency risk depends both on the amount of equity capital relative to assets and on the risk embedded in portfolios. Portfolio risk has been increasing. The share of bonds in life insurers' portfolios has been falling, and the shares of mortgages and alternative investments have been rising (**Figure 3-7**). The mix within categories matters as well. Among bond holdings, the share of high-yield bonds decreased to 5%, but the share of ABS and other structured securities grew to more than 13% at year-end 2023. The share of medium-quality and riskier commercial mortgages rose to 11%, more than doubling

since 2018. Alternative investments are more opaque, and less is known about their risk.

Figure 3-7. Life Insurers' Investment Portfolios (percent)



Sources: S&P Capital IQ Pro, Office of Financial Research

Property and Casualty Insurers

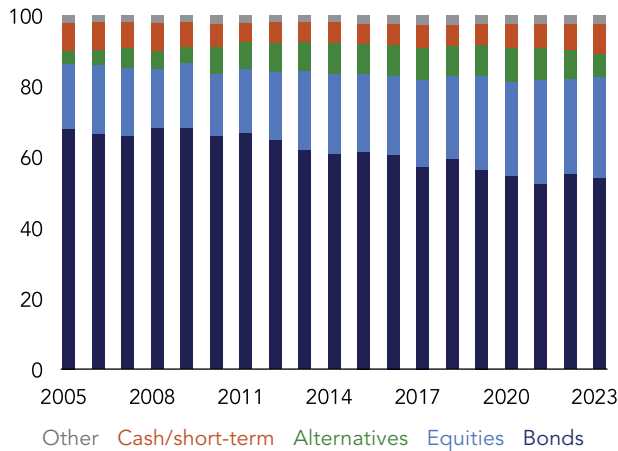
P&C insurers provide auto, home, business liability, and property insurance, as well as more specialized insurance. P&C insurers are vulnerable to insolvency from large-scale claims that exceed the insurers' claims-paying capacity.

The most obvious source of unusually large claims is natural disasters, such as hurricanes and wildfires that affect a sizable fraction of policyholders. Though the number and cost of such claims has been growing with the incidence of natural disasters, P&C insurers' ability to absorb the claims without impaired solvency is influenced by the premiums they charge. P&C premiums have risen in part because claims related to natural disasters have increased. Whether that rise is sufficient to cover future growth in claims costs is unclear.

Leverage (**Figure 3-6**) and portfolio risk is lower for P&C insurers than for life insurers. P&C insurers' investment portfolios (**Figure 3-8**) have shorter-duration assets because most claims

tend to be filed quickly, and soaring claims can require liquidating assets. P&C insurers are less leveraged, so their portfolios have more equity securities than life insurers' portfolios.

Figure 3-8. P&C Insurers' Investment Portfolios (percent)



Sources: S&P Capital IQ Pro, Office of Financial Research

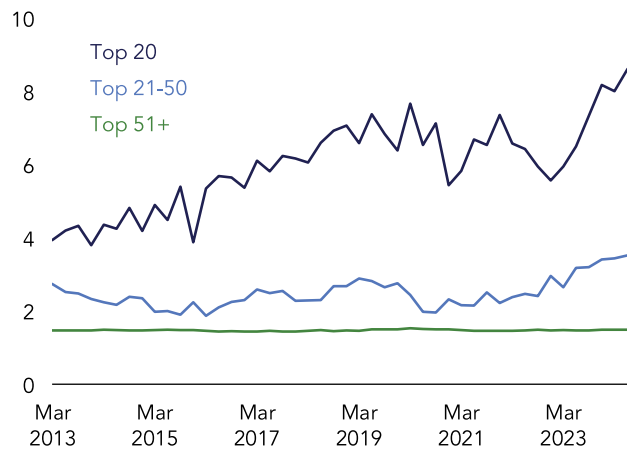
Hedge Funds

Hedge funds are investment vehicles that pool capital from many sources and provide several benefits to financial markets. For example, they perform arbitrage that reduces or eliminates price discrepancies across similar securities and instruments; they provide liquidity; and they add depth and breadth to capital markets. They also sometimes employ opaque trading strategies that involve leverage or short-term funding. If they abruptly pull back from markets, their departure may create or add to market stress.

This section focuses on what the Securities and Exchange Commission (SEC) defines as Qualifying Hedge Funds (QHF) because that category captures the largest U.S. hedge funds by asset size. These funds also tend to be the largest borrowers with the highest degree of interconnectedness with bank counterparties. QHFs are the only hedge funds that disclose information to the SEC quarterly.

As of Q2 2024, QHFs held about \$9.6 trillion in total gross assets and \$4.1 trillion in net assets, which are gross assets less liabilities. This means that on average, QHFs had a leverage ratio of about 2.3x. Leverage, however, was much higher for larger hedge funds, as it routinely has been. The net asset weighted-average leverage ratio of the 20 largest hedge funds by gross assets was more than 8x (**Figure 3-9**).

Figure 3-9. Average Leverage by Size Cohort



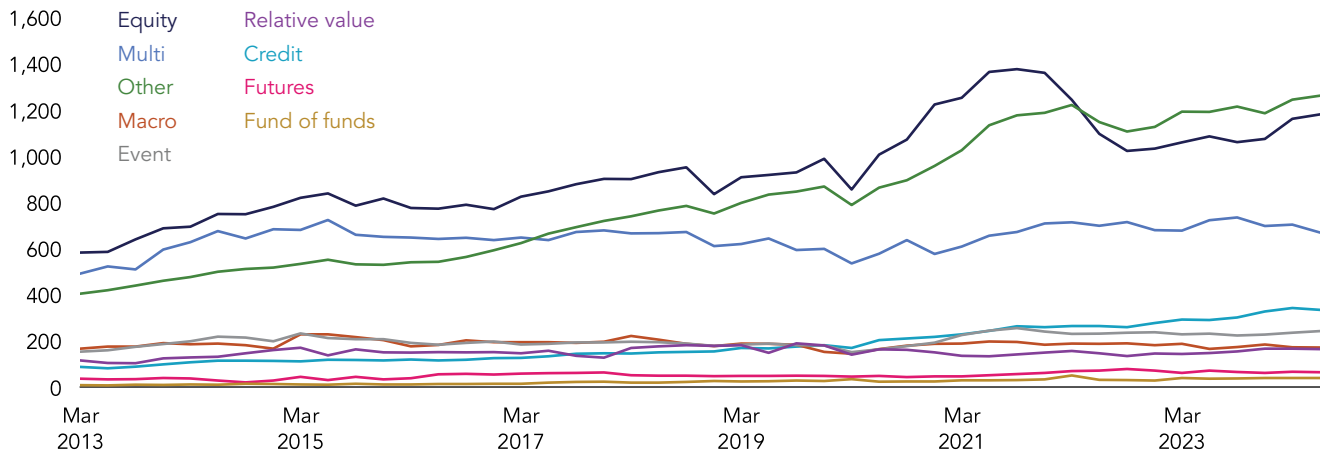
Note: Data as of June 30 2024. Data are from Securities and Exchange Commission Form PF questions 8 and 9 and reflect only QHFs. Leverage is the ratio of gross assets to net assets. Cohort leverage is a net asset weighted average across funds within cohort. Size cohorts are determined quarterly based on hedge funds' gross assets.

Sources: Securities and Exchange Commission Form PF, Office of Financial Research

Hedge funds following macro, relative value, and multi strategies routinely have the highest leverage. Across all strategies, leverage has grown most rapidly at macro and multi-strategy funds, rising for the four quarters ending Q2 2024 from roughly 5.1 to 6.7 and from 3.8 to 4.2, respectively. Leverage at relative value funds has been variable but fairly flat on average.

Hedge funds following equity, multi, and other strategies have the largest net asset values (NAVs) (**Figure 3-10**). Strategies classified as "other" do not fit into any SEC Form PF category. These other strategies have shown

Figure 3-10. Net Asset Value by Strategy (\$ billions)



Note: Data as of June 30, 2024, from the OFR Hedge Fund Monitor. Data reflect only QHFs and are from Securities and Exchange Commission Form PF questions 9 and 20.

Sources: Securities and Exchange Commission Form PF, Office of Financial Research

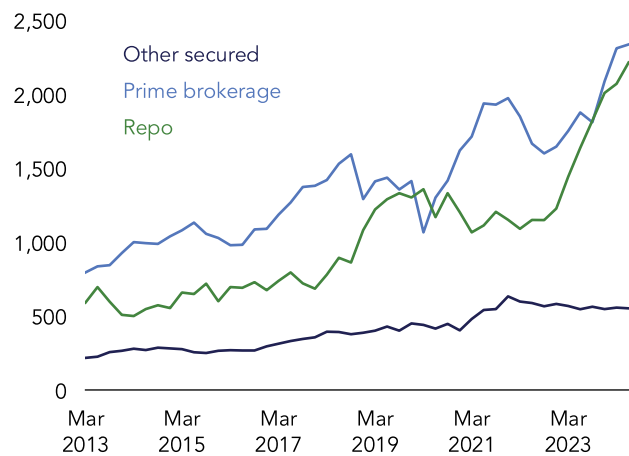
extraordinarily rapid growth during the past 10 years. For Q2 2024, many of the funds that self-report as “other” were private credit, real estate, or infrastructure investment funds.

Hedge funds are highly interconnected with the financial system. Most hedge funds obtain financing from securities dealers and bank affiliates that provide repo and prime brokerage loans. From Q4 2022 through Q2 2024, hedge fund repo borrowing surged 80% to more than \$2.2 trillion. During the same period, prime brokerage borrowing increased 42% to more than \$2.3 trillion (**Figure 3-11**).

A hedge fund that experiences material trading losses may have to rapidly unwind large, leveraged positions. The unwinding has the potential to increase market volatility and raise the risk of fire sales. In extreme situations, a highly leveraged fund that becomes insolvent as a result of the fire sales can, in turn, impose large losses on dealer counterparties that mismanage counterparty risks.

For the year ending Q2 2024, hedge funds’ gross exposure to Treasuries, Treasury futures,

Figure 3-11. Hedge Fund Borrowing (\$ billions)



Note: Data as of June 30, 2024, from the OFR Hedge Fund Monitor. Data reflect only QHFs and are based on Securities and Exchange Commission Form PF question 43.

Sources: Securities and Exchange Commission Form PF, Office of Financial Research

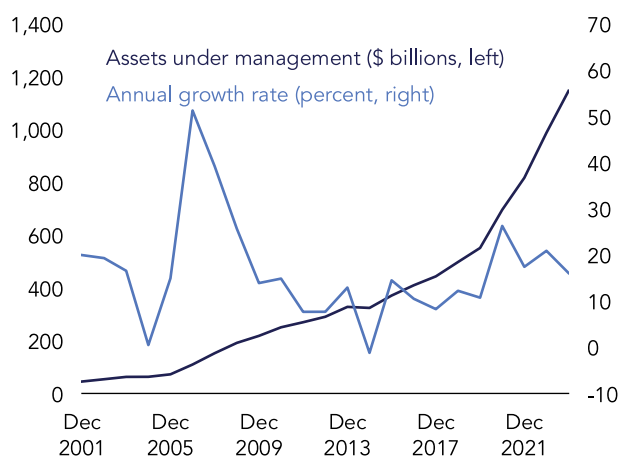
and other derivatives increased by \$858 billion. These exposures bring with them added risk; hedge funds may rapidly reduce their positions in Treasuries when asset prices change sharply, potentially decreasing market liquidity in stressed periods.

Individual hedge funds that follow multiple strategies draw upon shared liquidity pools and credit lines. This introduces the risk that unexpected, outsized losses in one strategy could force a disruptive deleveraging in other strategies. These spillovers may adversely affect unrelated markets, especially when the volatility of asset prices is high.

Private Lenders

Private lenders include closed-end funds that provide debt financing to real-economy entities (private credit funds), CLOs, and business development companies (BDCs). Assets managed by private credit funds have grown especially rapidly during the past decade (Figure 3-12).

Figure 3-12. Growth of the Private Credit Industry



Note: Data as of December 31, 2023.

Sources: Preqin, Office of Financial Research

Most private lenders specialize in investing in the high-risk debt of nonfinancial firms and households. For example, according to a Federal Reserve Board analysis, interest rates on loans made by private credit funds are far higher than those on leveraged loans.⁴⁰ Because interest rates are correlated with borrower

default risk, this implies that loans by private credit funds are riskier than leveraged loans.

Private lenders for which data are available are less leveraged than banks. Because their portfolio risk is high, less leverage does not necessarily mean that private lenders are less likely to become distressed from credit losses. Since private lenders are connected to the rest of the financial system through funding arrangements and shared credit exposure, their distress could propagate rapidly. The lack of data about private lenders' portfolio risk and leverage may obscure or worsen vulnerabilities in the financial system, especially as such lenders become larger and provide a greater share of debt financing for firms and households.

Mutual Funds and Exchange-Traded Funds

U.S. registered investment company assets exceeded \$36 trillion at the end of August 2024. This includes about \$20 trillion in open-end funds, excluding MMMFs, and about \$10 trillion in ETFs.

Open-end funds can invest in stocks, bonds, money market instruments, or other securities, as well as take on leverage, subject to limitations established under the Investment Company Act. These funds allow daily redemptions while potentially holding assets that can take longer than one day to sell.

The costs of redemptions are borne largely by investors that remain in open-end funds. This feature creates a first-mover advantage, an incentive for investors to redeem before others, especially when asset market liquidity is impaired. A first-mover advantage is also created when funds first sell their more liquid assets to meet redemptions, leaving remaining

investors with a less liquid portfolio. If investors anticipate that the liquidity of the remaining assets will continue declining, their incentive to redeem immediately will be even greater. This could lead to asset fire sales and broader market disruptions, particularly if the fire sales occur by multiple funds within a given asset class. These fire sales could create a feedback loop in which fund outflows and price declines are mutually reinforcing.

Some open-end funds invest in less-liquid assets. For example, many fixed-income securities are less liquid than equities. In a stress event, fund managers could encounter a significant reduction in the liquidity of portfolio assets. Assets in fixed-income open-end funds have continued to grow, increasing the vulnerability.

ETFs are pooled vehicles that hold a basket of securities and trade like stocks on an exchange. Typically, an ETF mirrors the performance of a stock, bond, or commodity benchmark or index. Since ETF shares trade on exchanges, they offer continuous pricing, unlike open-end funds that offer only end-of-day pricing. In contrast to an open-end fund that issues and redeems shares for the fund investor, the shares outstanding of an ETF change mainly when the ETF price diverges significantly from the value

of the underlying basket of securities. In such cases, an authorized participant exchanges securities or cash for ETF shares or vice versa.

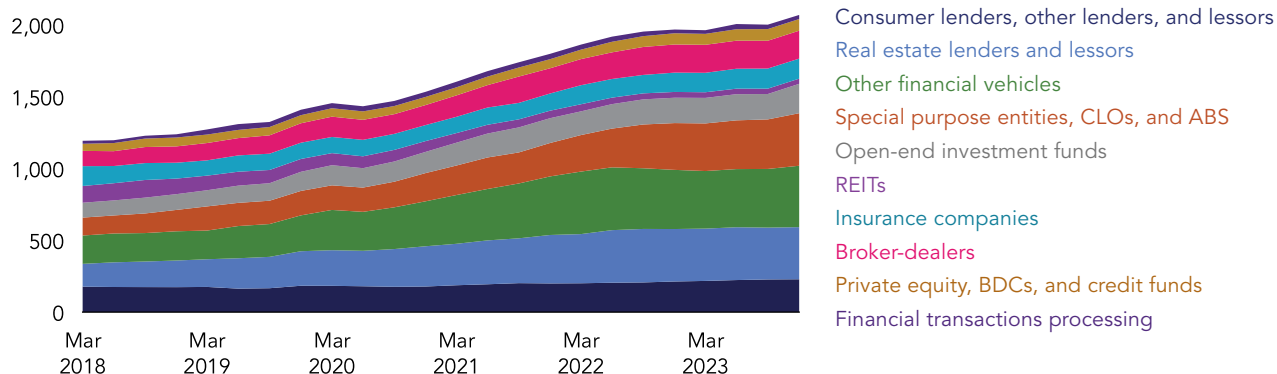
Financial system vulnerabilities associated with ETFs are fewer than for open-end funds, particularly for ETFs that exchange units for the underlying assets and vice versa. This type of ETF does not confer a material first-mover advantage on early redeemers, in contrast to open-end funds.

Lending to Nonbank Financial Institutions

Large banks directly lend to NBFIs, including hedge funds, private lenders, real estate investment trusts, and securities dealers. Some NBFIs, such as many private credit funds, specialize in high-risk strategies, increasing the risk to banks of losses on credit extended to NBFIs.

Total direct lending by U.S. global systemically important banks (G-SIBs) to NBFIs grew at a compound average annual rate of 12.3% from Q4 2018 through Q4 2022 and 5.2% in 2023, reaching a total committed exposure of \$2.1 trillion as of Q4 2023 (**Figure 3-13**). Most of the

Figure 3-13. Large Banks' Committed Exposures to Nonbank Financial Institutions (\$ billions)



Note: Data as of December 31, 2023.

Sources: Board of Governors of the Federal Reserve System Form Y-14Q (Schedule H.1), Office of Financial Research

growth in recent years has been to NBFIs for which the risks are relatively opaque.

Large banks also have substantial exposure to NBFIs from their provision of prime brokerage services. Although these exposures are collateralized and actively managed for risk, they can still cause large losses to banks from failures of risk management at the customers or the banks. As a case in point, the collapse of Archegos, a large family office, caused a handful of its prime brokers to suffer big losses in 2021. Credit Suisse suffered the biggest loss, \$5.5 billion, which contributed to Credit Suisse's demise in March 2023.⁴¹

Technology

The technology vulnerabilities of nonfinancial businesses discussed in the previous chapter are also present at financial institutions. What makes nonfinancial businesses different is that they are one step removed from the financial sector. In contrast, technology vulnerabilities at financial institutions can directly impair the provision of financial services, with possible systemic effects.

More specifically, many financial institutions offer direct access to customers' funds. This access makes them more attractive targets for fraud than the typical nonfinancial business. It also amplifies the potential stress to the financial system if they or a TSP of theirs suffer a technology failure or cyberattack. One concern is that a financial institution that experiences a technology disruption, malicious or not, could experience much larger costs and need additional funding. If the institution finds that its short-term funding is constrained, then its liquidity problem could become a solvency problem if assets must be sold. Runs could occur at other financial institutions if

those entities are thought to be at risk of the same event.

Many financial institutions are subject to oversight that extends to their operations and cyber defenses.⁴² This may give them a degree of resilience to technology disruptions that may be lacking at entities subject to less stringent regulation. The vulnerabilities that remain in their own cybersecurity and in that of their less-regulated TSPs expose them to cyberattacks and increase the risk to financial stability.

Insurance, whether for cyber events or operational disruptions, transfers some related financial risk from insured banks and other financial institutions to insurers. The uptake of cyber insurance is limited overall, but it is widely bought by financial institutions. Uncertainty exists about the extent to which insurance will cover catastrophic events. For example, cyberattacks by nation-states are generally excluded from cyber insurance coverage.⁴³ At the same time, the ability of the insurance sector to bear catastrophic losses remains a concern. The U.S. government is exploring, as a possible mitigant, a federal insurance response to catastrophic cyber incidents.⁴⁴

Technology Disruptions

The details of a technology disruption at a financial institution matter for financial stability. Was the disruption from an accident or error, or was it from a cyberattack? Was the disruption limited to one or more financial institutions, or was it at a common TSP?

Technology disruptions from accidents or errors can seriously impair the affected financial institution. Knight Capital's failure is an example. Knight provided market making, electronic trade execution, and institutional sales services. In 2012, its use of HFT made it the largest trader in U.S. equities markets until a software error

in its HFT algorithm caused a \$440 million loss within minutes, wiping out its capital. The firm received a capital injection of \$400 million from a group of financial firms, and it took a draw of \$200 million on a bank line of credit.⁴⁵

Events like those at Knight tend to be firm specific. As a result, investors are unlikely to worry that other institutions are at risk of the same event, making the risk of widespread runs low. In the longer run, knowledge of an incident at one institution can lead other institutions to take steps to reduce their risk of a similar event.

A cyberattack directly on a financial institution, like those that involve malware or ransomware, will force the victim to take affected computer systems offline. If some systems remain online, the institution could be subject to run risk when the attack becomes public. If all systems are offline, preventing account holders from withdrawing funds, run risk still exists for other financial institutions viewed as potential victims.

Even without run risk, a financial institution that suffers a cyberattack can experience a liquidity event. The attack on ICBCFS, described previously, is an example. The day after the attack was discovered, ICBCFS ended up owing BNY \$9 billion for unsettled trades. What was effectively an emergency loan from BNY kept ICBCFS going until its parent was able to provide a capital injection sufficient to repay BNY.⁴⁶ A financial institution without such a well-capitalized parent might have been forced to default. ICBCFS is considered a mid-size broker, but its default could have triggered a chain of defaults. Two weeks later, ICBCFS was still recovering from the attack.⁴⁷

Cyberattacks on TSPs to financial institutions have the potential to be more disruptive than attacks directly on a financial institution. Typically, a TSP takes its computer systems offline to protect its customers against the

spread of any malware. Its customers remain open, with their computer systems online. Their operations are impaired, and they implement their business continuity plans in an attempt to continue doing business without the TSP's services. This may involve switching to more manual and costly processes. An institution in a weak financial position might face considerable stress from the event. In this case, however, the financial institution is not more likely to experience a run because it did not experience a cyberattack itself.

The January 2024 ransomware event at EquiLend is an example. EquiLend provides a centralized securities lending platform for many large, global financial institutions. The platform normally handled more than \$2 trillion in transactions monthly and provided regulatory reporting services. EquiLend went offline after a cyberattack. During the service outage, customers resorted to manually tracking their transactions. Unable to see their actual securities lending, they allocated additional capital against their positions. Delayed regulatory reporting provided less visibility into market developments. EquiLend was offline for 10 days due to the attack, but its customers needed more time to be assured of its security and reconnect.⁴⁸

Fraud

The many cyberattacks within and outside the financial sector have put almost every household's personal and financial information in unauthorized hands. The data are being used to make fraudulent transactions on existing financial accounts, take over those accounts, and open new accounts in another's name. They also are used to commit fraud by creating convincing impersonations of real people and wholly synthetic identities with authentic documentation.⁴⁹

While financial institutions are using AI to detect financial fraud, AI is also making large-scale fraud far easier to accomplish. Generative AI facilitates social engineering, the development of malicious code, and the identification of weaknesses in computer systems. Financial institutions are vulnerable to large fraud losses if fraud-detection technology loses ground to AI-enabled fraud.

Surveys of risk and fraud professionals at U.S. financial institutions point to the rapid growth of fraud. More than 80% of institutions surveyed in 2023 by Forrester for LexisNexis had increased the resources they spent to manage fraud risk in the past 12 months. Fraud incidence was similar for the opening of new accounts, unauthorized access of accounts, and distribution of funds from those accounts. The surveyed institutions only prevented about half of the attempted fraudulent transactions. Every \$1 in losses from fraudulent transactions was associated with \$4.40 in total fraud costs, which include expenses for labor and investigation, legal fees, recovery, and some fraud prevention. Total fraud costs were up 9% from the 2022 survey.⁵⁰ A separate study found that 1,386 U.S. financial institutions with assets of at least \$1 billion experienced aggregate losses of \$2.7 billion from fraudulent transactions in 2023.⁵¹ If the LexisNexis multiplier of \$4.40 in fraud costs for every \$1 in fraudulent transactions applies to this study, then the total fraud costs for just the surveyed institutions were almost \$12 billion.

The Treasury Department has called for a clearinghouse for financial institution fraud data. Such a database could give financial institutions the benefit of training their AI fraud detection models on more comprehensive data.⁵²

4. Money Markets

Money markets support core functions of the financial system. They offer savers and investors access to very short-term debt instruments that have features similar to cash, or government-issued currency. Holders use these debt instruments to store value in cash substitutes that offer additional yield, to support their ability to make payments, and as collateral. Issuers use these debt instruments to manage the ebbs and flows of cash and to fund investments in other assets. Central banks use some of these instruments, mostly government-issued debt and repos, to achieve their interest rate targets. Money markets currently do not appear stressed, but that can change with little warning, in contrast to many other parts of the financial system in which stress develops more gradually.

Money markets are liquid when lenders can readily access their funds and borrowers can obtain funds when they want and at a relatively low cost. Some money market instruments involve the risk of default or an inability to quickly convert assets to cash. A sudden loss of confidence can lead to runs and asset fire sales, causing funding to become less available to money market borrowers. Stress in money markets can also disrupt the ability to make payments. Because money markets are essential to the functioning of the financial system, such stress can rapidly spread.

Vulnerabilities associated with money markets remain moderate. Data gaps remain in repo markets, although a new OFR data collection will reduce them. Money market institutions and instruments are subject to maturity and liquidity risks and associated run risk. In addition, banks and many NBFIs, including those with high leverage, are exposed to default risk from each other through their

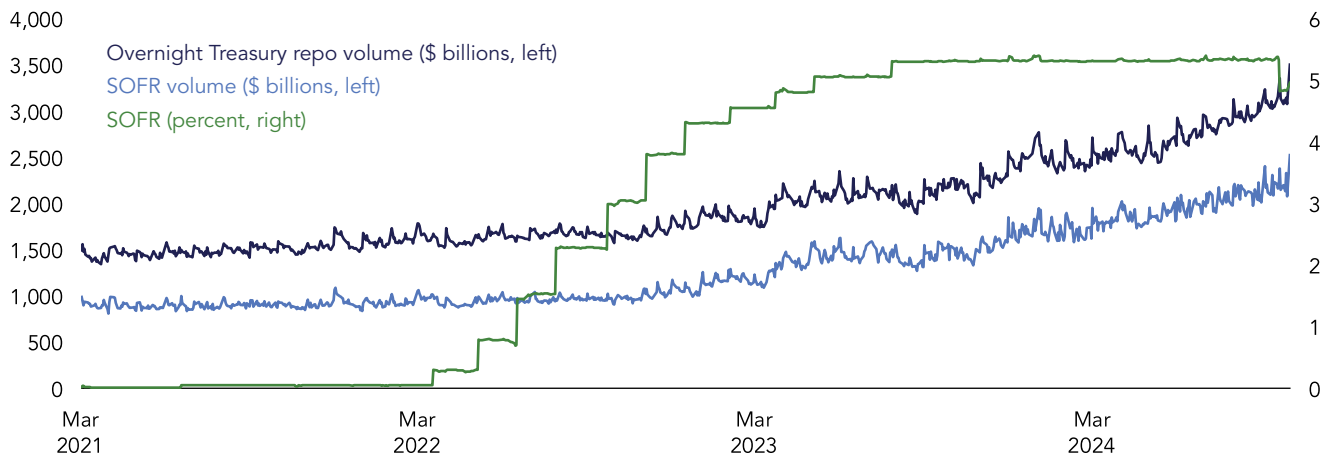
activities in money markets, especially repo markets. Some stablecoins are inherently susceptible to runs, and stablecoins generally are opaque, making their risk hard to assess. Technology vulnerabilities at FMUs and TSPs on which money markets rely expose payment flows and the broader financial system to the risk of destabilizing service outages.

Repurchase Agreements

A repurchase agreement or repo is a contract in which a market participant sells an asset with an agreement to buy it back. The price at which it is bought back, or repurchased, is typically higher than the selling price, providing the buyer an interest payment, so the seller is a cash borrower and the buyer a cash lender. Repos are attractive to lenders because they are collateralized and short-term; they are attractive to borrowers because they provide cash at low interest rates. They also can be used to source securities.

Repos are often issued with a one-day or overnight term and are rolled over. Overnight repos backed by Treasuries are the most common source of funding in financial markets. A portion of the volume is the basis for calculating the Secured Overnight Financing Rate (SOFR). The SOFR is a benchmark interest rate used to determine interest payments for many financial instruments, including floating-rate bonds and loans, adjustable-rate mortgages, and derivatives (**Figure 4-1**). This rate replaced the London Interbank Offered Rate (LIBOR) in 2023 as the primary benchmark rate. If activity in repo markets freezes and the SOFR cannot be calculated, many financial contracts across the household and business sectors would be disrupted. The Federal

Figure 4-1. SOFR, SOFR Transactions, and Overnight Treasury Repo Volume



Note: Data as of September 30, 2024. Overnight Treasury repo volume includes DVP overnight, GCF Treasury repo, and tri-party Treasury transactions but excludes the Federal Reserve’s Overnight Reverse Repo Facility. SOFR volume includes all trades in the broad general collateral rate plus bilateral Treasury repo transactions cleared through DVP.

Sources: Federal Reserve Bank of New York, Office of Financial Research

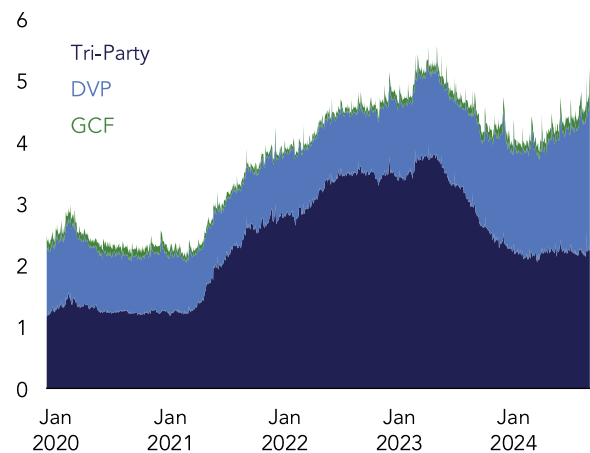
Reserve’s repo facilities create a floor and a ceiling on repo interest rates, which mitigate this risk.

U.S. repo markets are among the largest and most liquid short-term funding markets in the world. Total repo volume has been rising since 2021 (**Figure 4-2**). The OFR estimates that more than \$4 trillion is outstanding.⁵³ The rise is partly attributable to changes in the role of repo markets in the Federal Reserve’s implementation of monetary policy.

The market is comprised of four segments (**Figure 4-3**). Repos can be categorized based on whether they are settled via a third party (tri-party) and cleared by a clearinghouse or CCP. Regulators currently collect data for three of the four segments to monitor vulnerabilities. The OFR will soon be able to monitor the remaining segment through a permanent data collection of NCCBR trades. The collection is scheduled to begin in December 2024.

Dealers stand in the middle of repo markets and intermediate cash and collateral across the segments. They borrow cash secured by

Figure 4-2. Repo Transaction Volumes (\$ trillions)



Note: Data as of September 30, 2024, from the OFR Short-Term Funding Monitor. Overnight Treasury repo volume includes DVP overnight, GCF Treasury repo, and tri-party Treasury transactions but excludes the Federal Reserve’s Overnight Reverse Repo Facility.

Sources: Federal Reserve Bank of New York, Office of Financial Research

collateral from one counterparty in a reverse repo transaction. They then relend that cash for collateral to another counterparty in a repo transaction. That is, they provide value by accepting collateral from institutions that want to borrow cash, and they lend that

Figure 4-3. The Four Main Segments of the U.S. Repo Market

		Settlement	
		Tri-Party	Bilateral
Clearing	Centrally Cleared	FICC GCF Repo <ul style="list-style-type: none"> Centrally cleared by FICC Settled on BNY's Tri-Party platform General collateral repo only 	FICC DVP Service <ul style="list-style-type: none"> Centrally cleared by FICC No central custodian Specific collateral repo possible
	Non-Centrally Cleared	BNY Tri-Party <ul style="list-style-type: none"> No central counterparty Settled on BNY's Tri-Party platform General collateral repo only 	Non-Centrally Cleared Bilateral Repo <ul style="list-style-type: none"> No central counterparty No central custodian Specific collateral repo possible

Note: FICC = Fixed Income Clearing Corporation.

Source: OFR Brief "Why Is So Much Repo Not Centrally Cleared? Lessons from a Pilot Survey of Non-Centrally Cleared Repo Data" published May 12, 2023.

collateral to other institutions (see **Repo Market Intermediation**).

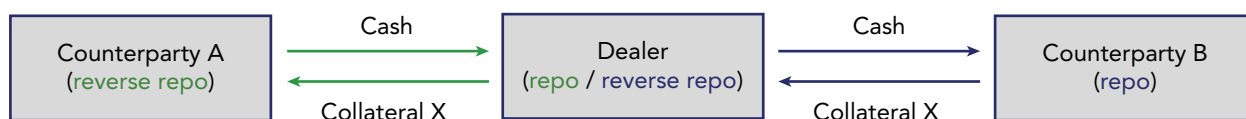
If large repo lenders suddenly decide not to roll over repo, dealers must quickly find other sources of financing or sell assets, which may transmit repo market stress to other markets. For example, many dealers lend to hedge funds using funds borrowed through repos

with MMMFs. Withdrawals from MMMFs can be quickly transmitted to hedge funds via repo markets. Dealers and other market participants manage these risks, typically by collecting margin, although more information about their margining practices would be valuable (see **Data Gap Regarding Dealer Margining Practices**).

Repo Market Intermediation

Repo dealers play a pivotal role by serving as go-betweens, or intermediaries, for borrowers and lenders (**Figure 4-A**). Often, dealers pass the collateral received from one counterparty to another. They lend to the first and borrow from the second, a practice known as rehypothecation.

Figure 4-A. Repo Dealer Intermediation



Note: This figure provides a simple example of how a dealer intermediates cash and collateral between counterparties A and B. The dealer borrows cash in a repo with counterparty A on the left and then, on the right, lends cash against that same piece of collateral in the reverse repo with counterparty B.

Source: Office of Financial Research

OFR researchers show that dealers tend to reuse a large portion of the cash and collateral from transactions.⁵⁴ The research finds that dealers rehypothecate 65% of their reverse repo collateral, the equivalent of \$607 billion of repos outstanding.

Rehypothecation is not free of risk. Market participants differ in their preferences for repo contract terms (that is, interest rates, maturities, etc.). Because dealers sit in the middle of the transactions, they are exposed to counterparty, collateral, liquidity, and maturity risks. Market volatility in the value of the underlying collateral may prompt a dealer to lend less against the collateral in the face of uncertainty. Changes in the term profile of a dealer's repo commitments can cause the dealer to reduce lending.

Managing these risks becomes more challenging for dealers during economic downturns. Notably, during the 2007-09 financial crisis, some repo dealers saw decreases in funding supply due to concerns over counterparty risk and collateral quality. For example, Lehman Brothers lost access to most of the funds it had obtained in repo markets as its exposure to the mortgage market became more salient. This was a run on repo, similar to a traditional bank run.

Interconnectedness created by the high rate of rehypothecation in the United States highlights the potential for spillovers across the financial system.

Data Gap Regarding Dealer Margining Practices

Margining is a risk management practice employed by financial institutions to mitigate the risk of default and to provide a buffer against potential losses. This practice requires counterparties to deposit collateral in proportion to perceived risk. Financial instability may occur when traders are unable to make margin payments, creating funding strains for dealers. When dealers become less willing to make markets in distressed financial conditions, the risk of sudden adverse price movements and fire sales increases.

While regulators have data on margin practices in centrally cleared and exchange-traded markets, they lack similar visibility into non-centrally cleared over-the-counter (OTC) market segments. The OFR developed new insight into this market segment through its 2022 pilot data collection on the NCCBR market segment. However, data gaps and a lack of understanding about margin practices remain.

Collateral haircuts are one type of margining practice. Haircuts in repo markets are the difference between the collateral's market value and the loan amount. This difference serves as a buffer to protect repo lenders from a decline in the collateral's value. Zero-haircut trades have no buffer. Using the OFR's 2022 pilot data collection, OFR researchers find a prevalence of zero-haircut trades in the NCCBR market segment, particularly for transactions using U.S. Treasury securities as collateral (**Figure 4-B**).⁵⁵

Zero haircuts may occur when there is low risk or because of alternative margining practices. Dealers may perceive that Treasury securities pose little risk, which might support zero haircuts. However, nonzero haircuts on Treasury securities prevail in the tri-party segment of repo markets. Alternatively, zero-haircut trades in the pilot data may simply reflect the practice of cross-margining or portfolio margining. These practices are more prevalent in OTC markets.

Figure 4-B. Rates and Haircuts Across Collateral Classes in NCCBR

Collateral Type	Haircut Range					
	Haircut (percent):	<-2	-2 to 0	0	0 to 2	>2
Treasury	Volume (\$ billion)	21.6	40.6	593.9	108.9	38.0
	Share of Total (percent)	2.7	5.1	74.0	13.6	4.7
	Haircut (percent):		<0	0	0 to 5	>5
Non-Treasury	Volume (\$ billion)		2.0	26.2	34.9	43.7
	Share of Total (percent)		1.8	24.6	32.7	40.9
	Haircut (percent):		<0	0	0 to 5	>5

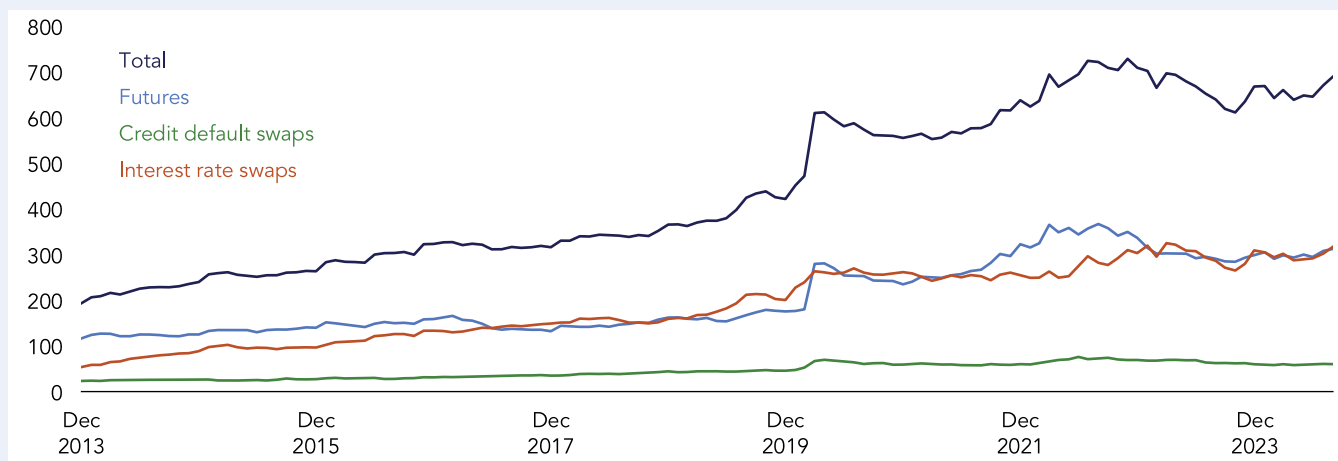
Sources: 2022 OFR NCCBR Pilot Collection, OFR Brief “Why Is So Much Repo Not Centrally Cleared? Lessons from a Pilot Survey of Non-Centrally Cleared Repo Data” published May 12, 2023.

The concepts of cross-margining and portfolio margining are related. Cross-margining involves the calculation of margin across positions. Excess margin from one position can be transferred to another to meet margin requirements. In contrast, portfolio margining involves calculating margin to cover changes in the value of an entire portfolio rather than for each position independently.

Portfolio margining may also occur across asset classes. For example, portfolio margining may account for offsetting repo and futures positions, such as in a basis trade. Portfolio margins may augment or replace the haircuts applied to the repo collateral. Thus, the observed prevalence of zero-haircut trades in the NCCBR segment of the market may be from margin that is managed at the portfolio level, whereas the OFR’s pilot collected data only on individual repos.

Understanding dealer margining practices is important for financial stability. For example, during the COVID-19 pandemic, markets experienced heightened volatility and sharp asset price declines. Consequently, many broker-dealers increased margin requirements to manage their own risk.⁵⁶ This forced investors to post additional collateral or liquidate positions, creating additional

Figure 4-C. Initial Margin Requirements (\$ billions)



Note: Data as of August 30, 2024. All values are for the end of the month.

Sources: Commodity Futures Trading Commission Monthly Cleared Margin Report, Office of Financial Research

stress on the financial system. The example highlights the importance of broker-dealer margining practices. In centrally cleared and exchange-traded markets subject to Commodity Futures Trading Commission (CFTC) reporting requirements, the aggregate margin increased 30% from about \$472 billion in February 2020 to a peak of \$612 billion in April 2020 (**Figure 4-C**). The increase amplified market stress because some investors sold assets at depressed prices to meet margin calls.

Data on margining are readily available for centrally cleared and exchanged-traded markets. In the latter case, margining practices are generally standardized by security or derivatives market segment. In the former case, they are uniformly managed. These characteristics aid data collection. In contrast, in non-centrally cleared and OTC markets, margining practices are not standardized, and portfolio margining can occur across several classes of securities, such as derivatives and repos. These bespoke risk management practices and non-centrally managed margins have made collecting data on margins challenging for regulators.

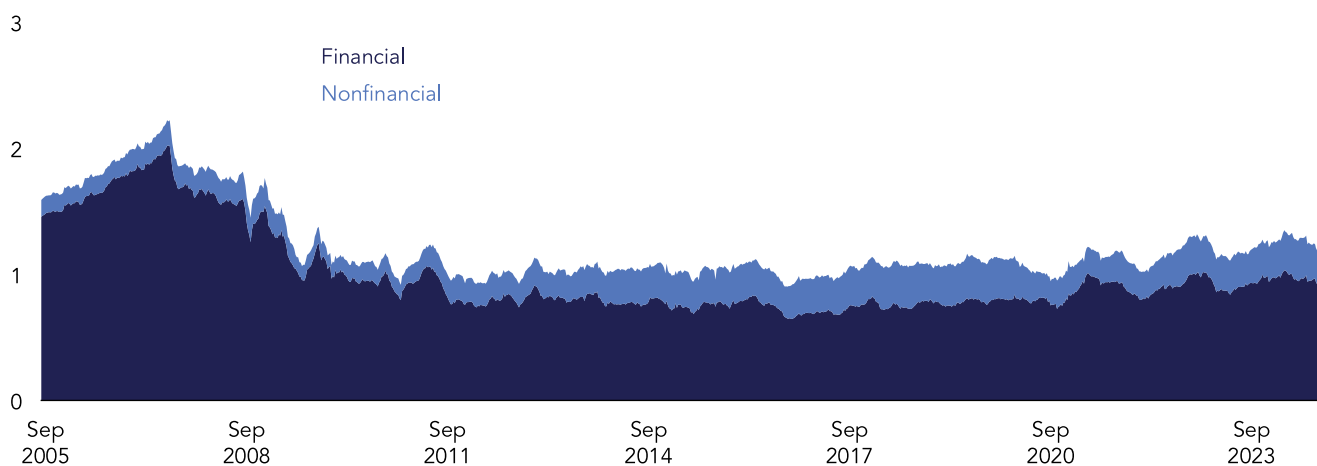
The inability to observe dealer margining practices, as in the NCCBR market segment, represents a data gap. This data gap hinders regulatory bodies' ability to fully assess and monitor the associated risks, underscoring the need for margin data collection. This blind spot is particularly concerning for repo markets and poses a financial stability vulnerability.

Commercial Paper

Commercial paper (CP) is a short-term debt security, often issued through a dealer. Most of the time, CP is perceived as posing a very low risk of nonpayment.

U.S. dollar-denominated CP outstanding was \$1.2 trillion at the end of September 2024, and little changed from recent years. Most commercial paper is issued by financial institutions and asset-backed structures, not by nonfinancial corporations (**Figure 4-4**). Relatively few nonfinancial corporations have

Figure 4-4. Weekly Commercial Paper Outstanding by Issuer Type (\$ trillions)



Note: Data as of September 25, 2024. The nonfinancial category can include financial and nonfinancial issuers rated A2/P2 by Moody's Ratings.

Sources: Board of Governors of the Federal Reserve System, Haver Analytics, Office of Financial Research

the credit rating necessary to make CP issuance attractive. Because CP is short-term, investors usually hold the paper to maturity.

CP vulnerabilities include those associated with runs and maturity transformation. A primary cause of runs is a sudden change in views about issuer creditworthiness. The large decline in outstanding CP during the 2007-09 financial crisis was associated with a loss of confidence in some types of financial CP, especially asset-backed CP. Issuers at the center of the loss of confidence were not able to roll over their CP and instead had to repay at maturity or default.

Almost by definition, CP issuers are perceived as safe; otherwise, they would be unable to issue. For this reason, run vulnerabilities routinely appear low. However, perceptions of soundness can change quickly; the 2023 failure of Credit Suisse is an example (although CP did not contribute materially to the firm’s failure). In recent years, the largest financial borrowers in dollar-denominated CP markets have been major non-U.S. banks seeking funding for dollar-denominated businesses.

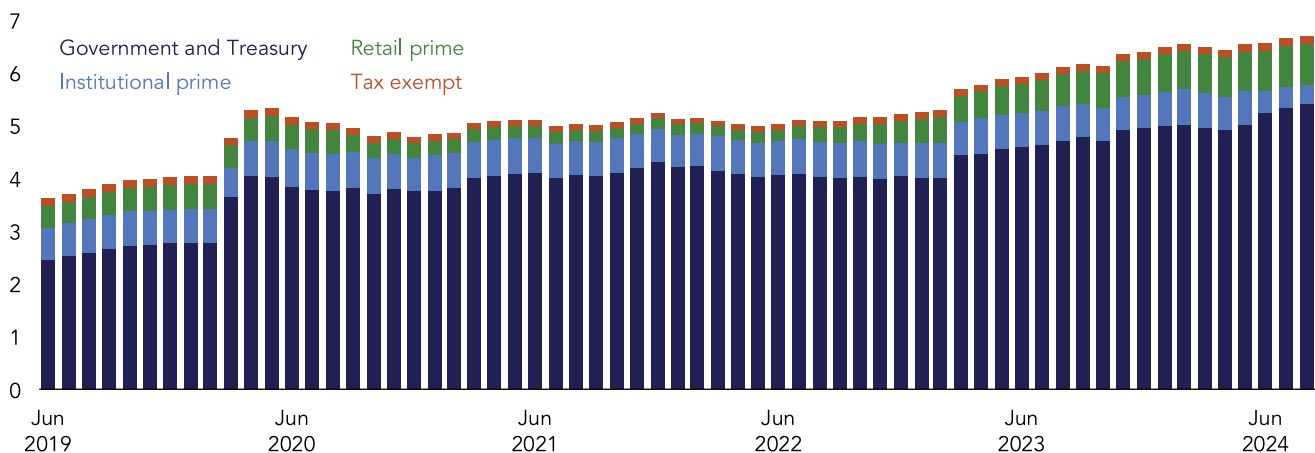
Many borrowers use CP to fund securities inventories. For example, some foreign banks use CP as part of their strategy to fund trading-related businesses. While the size of a dealer’s inventory of securities and its outstanding CP may vary daily, it will not go to zero. Thus, using CP to finance this inventory is a form of maturity transformation. A loss of funding from the CP market could mean the dealer would have to cease operations, rapidly selling its inventory, if it were unable to find other sources of funding.

Money Market Mutual Funds

MMMFs accept funds from retail, commercial, and government entities. Withdrawals from MMMFs are settled the same day or overnight, and balances can quickly be moved to another investment. MMMFs place the funds in a variety of short-term investments such as repo, CP, and Treasury bills. At about \$6.7 trillion as of August 2024, MMMF assets are large (**Figure 4-5**).

MMMFs are subject to runs if their investors become concerned that they may not be able to withdraw funds on demand at par value. The only way to prevent run behavior is for MMMFs

Figure 4-5. U.S. Money Market Mutual Fund Assets by Fund Type (\$ trillions)



Note: Data as of August 31, 2024.

Sources: Securities and Exchange Commission Form N-MFP, Office of Financial Research

to invest solely in money market instruments with a one-day maturity and issued by entities certain to repay on time. As a practical matter, a sizable share of all MMMF instruments have maturity dates longer than one day. MMMFs' vulnerability does not change over time, in part because money market instruments almost by definition are perceived as safe until they suddenly are perceived differently.

MMMFs are a significant source of short-term funding for longer-term assets and an important cash-management vehicle for investors. Their investments create a web of connections with the rest of the financial system (**Figure 4-6**). These connections can rapidly transmit adverse shocks at MMMFs across global funding markets.

Institutional and retail prime funds differ from U.S. government funds in their ability to invest in the unsecured obligations of private-sector entities. Though such investments are perceived as safe, they carry more credit risk than government obligations. Over the years, prime funds have experienced more sudden outflows akin to runs than government funds.

The most recent episode was in March 2020. Regulations were revised in 2023 with the goal of reducing MMMFs' vulnerability to runs.⁵⁷

Several types of institutional MMMFs are required to report floating NAVs, but some investors may be concerned that NAVs will fall well below \$1. In earlier periods of stress, MMMF sponsors played a critical role in preventing NAVs from falling below \$1. They also have mitigated potential spillovers to affiliate funds and short-term funding markets more broadly. However, uncertainty about the availability and capacity of sponsor support has also fueled runs. As industry assets have grown relative to sponsors' capital resources, risks associated with reliance on sponsor support have increased.

Stablecoins

Stablecoins are digital assets the value of which is supposed to remain constant relative to a reference asset, such as the U.S. dollar. The total market value of outstanding stablecoins was more than \$172 billion in September 2024 (**Figure 4-7**). The issuers of the two largest

Figure 4-6. Select Money Market Instruments

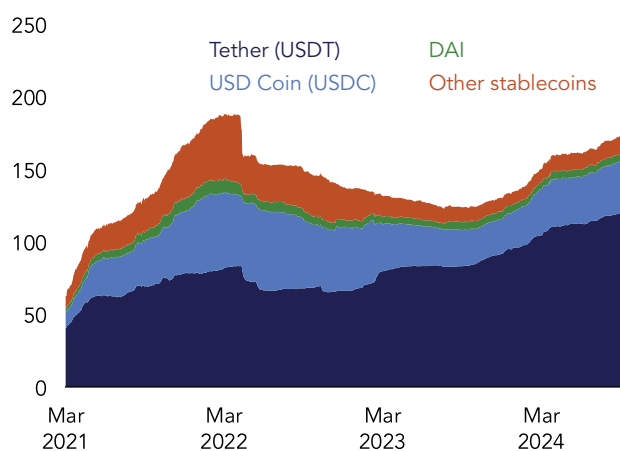
	Q4 2008		Q1 2020		Q2 2024	
	Outstanding Amount (\$ trillions)	MMMF Share of Outstanding Amount (percent)	Outstanding Amount (\$ trillions)	MMMF Share of Outstanding Amount (percent)	Outstanding Amount (\$ trillions)	MMMF Share of Outstanding Amount (percent)
Treasury Bills	2.41	25	4.16	33	8.06	30
Federal Home Loan Bank Obligations	1.26		1.18	64	1.18	51
Repurchase Agreements	3.52	16	4.71	33	6.17	42
Commercial Paper	1.60	40	1.08	29	1.22	23

Note: FHLB amounts include term obligations and are from the OFR Money Market Fund Monitor.

Sources: Board of Governors of the Federal Reserve System, Haver Analytics, Federal Home Loan Banks Office of Finance, Office of Financial Research

stablecoins—USDC and Tether—together held nearly \$92 billion in Treasury bills and more than \$29 billion in overnight repo as of June 2024.⁵⁸ The sum exceeded the assets of most individual Treasury MMMFs. Stablecoins have more volatile flows than MMMFs and significantly less ability to anticipate liquidity demands.

Figure 4-7. Top Stablecoins by Market Capitalization (\$ billions)



Note: Data as of September 30, 2024. Data represent daily stablecoin market capitalization.

Sources: DefiLlama, Office of Financial Research

Stablecoins can be used to make digital asset transactions but are rarely accepted as payment in the traditional economy. There are three additional important differences between stablecoins and most traditional money market instruments. First, some stablecoins are issued by private companies rather than bankruptcy-remote trusts. Some of these companies do not make unconditional promises to redeem. Second, the issuers have different mechanisms for maintaining their peg to the currency of choice. Third, if the issuing company declares bankruptcy, there is ambiguity about the holder’s claim to the underlying assets.

Stablecoins have structural vulnerabilities similar to MMMFs and other vehicles that

offer on-demand withdrawals. The issuers’ ability to meet withdrawal requests depends on the liquidity of the assets they would sell to fund the requests. That liquidity can dissipate in periods of market stress. The majority of stablecoins have a value pegged to that of the U.S. dollar. The peg is typically maintained by investing dollars deposited in dollar-denominated short-term assets that stablecoin investors have confidence can quickly be converted into cash, although other methods of maintaining the peg have been used with mixed success. Flows of dollars into and out of stablecoins affect the demand for such assets and, thus, the traditional financial system. However, gaps in regulatory authority remain for stablecoins, like other digital assets. The 2022 failure of the Terra stablecoin is an example of a bank-run-like event in the stablecoin space.

Vulnerabilities associated with stablecoins remain elevated. Issuers of the dominant stablecoins continue to invest a material fraction of their reserves in illiquid or volatile assets. For example, as of June 30, 2024, more than 12% of the assets that support Tether’s value were in Bitcoin, precious metals, and secured loans.⁵⁹

Technology

Money markets increasingly operate on a real-time basis. Little room is left for disruptions to the flow of funds or the processing of payments. Technology vulnerabilities heighten the risk of such disruptions, with the potential for widespread financial and economic fallout.

Activity in money markets relies heavily on a set of very large FMUs that operate platforms for transferring, clearing, or settling payments and other financial transactions. In essence, the FMUs ensure that money and other assets

are transferred as intended by the buyers and sellers in transactions. Technology vulnerabilities and other events that disrupt the functioning of these FMUs raise the risk that liquidity or credit problems spread among financial institutions and markets. In the extreme, these problems could impair financial stability.

So far, the financial system has withstood numerous technology disruptions at FMUs. For example, Fedwire, a settlement system operated by the Federal Reserve Banks that allows the electronic transfer of funds between financial institutions, has had several technology disruptions. Two service outages occurred in 2019. In the first, Fedwire was down for several hours. In the second, the Federal Reserve-operated automated clearinghouse (ACH) network was unavailable for 16 hours. At the time, the ACH network was processing about 58 million electronic payments, worth more than \$100 billion daily.⁶⁰ Two years later, an operational error took down many Federal Reserve financial services, including Fedwire and the Fed's ACH network.⁶¹

Major banks and other financial institutions that serve as sole or dominant operators of essential financial services also have suffered disruptions. Because these institutions, like FMUs, are single or near-single points of failure, their technology vulnerabilities pose a greater risk to financial stability. For example, between 1985 and today, BNY went from being one of four financial institutions serving as a settlement agent for Treasury securities to being the only one. BNY has had several technology failures over the years that left the firm unable to deliver Treasuries and other securities over Fedwire from sellers to buyers. In 1985, it received what, at the time, was the largest discount window loan in history to cover the overdraft of its Fedwire account that resulted from a software error.⁶² More recently, in 2016, another

technology problem prevented BNY from processing payments among international banks for 19 hours. At the time, it regularly processed about \$1.6 trillion in such payments daily.⁶³

Not all technology disruptions in money markets are accidents or occur directly at FMUs or financial institutions. Cyberattacks and other technology problems at TSPs to the financial system can also disrupt payment flows. A case in point is the cyberattack at Finastra in March 2020. Finastra, a TSP that provides core technology services to the banking system, suffered a ransomware attack and took its systems offline. The banks that used its suite of services had their operations disrupted for days while Finastra worked to rebuild its systems. The lack of access to Finastra's automated wire transfer service was particularly disruptive. Banks that relied on that service to send payments over Fedwire had to implement their business continuity plans to send payments, but payment flows were still interrupted.⁶⁴

The expense and lack of interoperability of TSPs' bundled bank technology services largely preclude banks from building resilience by maintaining redundant technology packages across TSPs. Even if that were not the case, migrating operations to a new TSP is a lengthy effort. Finastra reported having 9,000 financial institutions as customers, including almost all of the 50 largest banks globally at the time of the cyberattack, but only about 3% of U.S. banks were customers. Its limited U.S. footprint buffered the effect of its service outage on the U.S. financial system.⁶⁵

In summary, to date, U.S. money markets have suffered only limited disruptions to their functioning due to technology-related issues. One reason is the efforts by the FMUs and TSPs in those markets to make their technology as failsafe as possible. Another reason is the

FMUs' fallback plans for when technology does not work as intended. However, the many technology-related disruptions that have occurred are cautionary tales about the potential for a more severe event. How well the U.S. financial system will respond to such an event remains to be seen.

PART TWO:

STATUS OF THE OFFICE OF FINANCIAL RESEARCH



This section of the report details the Office’s organizational efforts in meeting its mission. In FY 2024, the Office pursued two strategic goals: 1) supporting the financial stability work of the Council and 2) achieving organizational excellence.

Through our efforts to achieve our mission, we advanced insights into financial stability through our long-term research and short-term analysis; our risk measurement and monitoring tools; our provision and collection of data; and our engagements related to data standards. We also continued maturing the organization while sustaining our focus on advancing the OFR workforce. We executed on opportunities that strengthened our supplier base, team capability, technology infrastructure, and planning for the future—improving our ability to serve the Council and its member agencies and support our people.

1. Support the Financial Stability Work of the Council

By working closely with the Council, the Treasury Department, and the Financial Research Advisory Committee, we collaboratively identified important financial stability issues to address. During FY 2024, we completed several strategic initiatives that manifested in various outputs, research and analysis, real-time monitors, Council support, data initiatives, and the promotion of financial stability research. These initiatives focused on subject areas that are sources or targets of financial stability risk or inform financial stability analysis. While there were many accomplishments and much progress, the following were the major successes during the fiscal year.

Research and Analysis

Our Research and Analysis Center (RAC) conducts applied and essential long-term research and analysis to support the stability of the U.S. financial system. RAC developed financial stability monitors, researched and

briefed the Council and other stakeholders, and evaluated financial stability policies to promote best practices in financial risk management. RAC applied its advanced analytical capabilities and deep subject-matter expertise to address various questions related to financial markets, financial institutions, and the connections between them and the broader economy. Research initiatives in 2024 focused on core financial system vulnerabilities and vulnerabilities that originate, in part, outside the traditional financial system, such as technology and digital asset risk. RAC also leveraged collaborative partnerships to expand the scope and impact of financial stability research.

Financial Sector Technology and Cybersecurity Risks

Technology is extensively used within the financial system. Disruptions to technology, whether benign or malicious in origin, present an increasing threat to financial

stability. Malicious disruptions in the form of cyberattacks are of particular concern because they can be timed and targeted for maximum effect. The cybersecurity of financial institutions and financial market utilities is especially critical to safeguarding the functioning of the U.S. financial system. We seek to understand the risk of cyber catastrophes for the financial system and how operational dependencies across institutions, markets, and technology providers affect that risk. To this end, we continue to acquire commercial datasets and tools that provide visibility into potential cybersecurity vulnerabilities at businesses and their technology service providers.

Wholesale Funding and Liquidity Management

Wholesale funding includes financing vehicles—such as interbank lending, repo, and debt securities issued for MMMFs—that banks and nonbank financial intermediaries use to expand their balance sheets. In line with the Final Rule on NCCBR transactions issued in May 2024, we will collect daily transaction-level data from certain financial companies on their NCCBR trades starting in December 2024. This initiative fills a data gap that became apparent after the March 2020 Treasury market disruptions, in which NCCBR trades were pivotal. The collected data will provide visibility into how risks are building in the financial system and support efforts by the Council and the OFR to identify and monitor risks to financial stability. With access to these data, we seek to understand how financial institutions effectively manage liquidity needs and requirements.

Central Counterparties

Since the 2007-09 financial crisis, financial firms have been incentivized to clear their

trades through CCPs, which have grown into key players in the global financial system. Assessing the preparedness of CCPs is critical, particularly for their ability to withstand severe market stress and counterparty default. These events could lead to large demands for margin payments that would stress CCP resources and could force CCPs to default. We developed a new framework for assessing the adequacy of CCPs' risk management strategies and their ability to meet their obligations during severe financial stress. These efforts are intended to provide valuable information not currently available from other agencies and to help Council member agencies understand the interconnected risks posed by CCPs within the United States and abroad.

Digital Assets

The interconnectedness of traditional financial markets and the digital-asset ecosystem creates avenues for contagion. For example, shocks that disrupt digital asset-backed exchange-traded products or stablecoins can propagate to the broader financial system. As a result, digital assets have come into focus as posing a potential risk to financial stability. We are developing the capacity to monitor this risk. Toward this end, we continue to acquire commercial and supervisory datasets that provide visibility into traditional financial linkages and vulnerabilities to these new and evolving financial instruments.

Climate-Related Financial Risks

Climate-related financial risks arising from physical impacts, such as extreme weather events and rising sea levels, and transition risks, like those associated with shifts in government policy and regulation, can manifest in various forms. These forms include increased insurance costs, asset devaluation, supply chain

disruptions, and credit losses. Each has the potential to affect financial stability. Under the President’s Executive Order on Climate-Related Financial Risk, we supported the Council Climate-Related Financial Risk Committee in collaboration with other Council member agencies. We have contributed to research- and data-focused working groups supporting the committee’s work and developed new intergovernmental partnerships to support interdisciplinary research.

Partnerships

Partnering with other organizations to promote financial stability research and discourse is critical to leveraging our expertise and focusing external experts on financial system vulnerabilities that may not receive sufficient attention. The National Science Foundation (NSF) used funds provided by the OFR to award a grant to the National Bureau of Economic Research (NBER). The NBER, in turn, has been instrumental in supporting research on financial stability topics with initiatives such as the Financial Frictions and Systemic Risk Project and the Financial Market Frictions and Systemic Risks Conference. Another partnership was with the Defense Advanced Research Projects Agency (DARPA), a research and development agency of the United States Department of Defense, to develop research on risks to the U.S. financial system from a cyberattack. We provided advice and feedback on DARPA’s Ensuring Consistency of Systemic Information program, which aims to develop innovative techniques for the robust recovery of federated financial information systems.

We also leveraged partnerships to host conferences this year. We partnered with the Review of Corporate Finance Studies to cohost the “Rising Scholars Conference: The Future of Financial Stability” on May 3, 2024, and with

the Federal Reserve Bank of Cleveland to cohost our annual Financial Stability Conference on November 16-17, 2023. These conferences convened experts to present research on financial stability and discuss related policy issues. A full list of conferences hosted or supported by the OFR, speaking engagements, and publications can be found in **Appendix C**. These partnerships are important for expanding the audience for and understanding financial stability vulnerabilities.

Monitoring Tools

We published the new HFM on the public website in July 2024. In addition to operating and maintaining our portfolio of five web-based monitoring tools, we also implemented significant enhancements to the BSRM, STFM, and MMFM that improve monitor production, data visualizations, and the overall user interface and experience.

Enhancements to the web-based monitoring tools included:

Bank Systemic Risk Monitor

The BSRM was enhanced to include a “Leverage/Assets/Equity” tab option. This addition allows users to view the new “Tier 1 Leverage Ratio” and “Supplementary Leverage Ratio” options. These additional views provide enhanced details for analyzing the bank holding company’s leverage.

Hedge Fund Monitor

We launched a new HFM in July 2024. This interactive data visualization tool makes aggregated data on hedge fund activities from public and private sources more accessible through an easy-to-use online tool. The monitor is available for public use, and the data are available for download via

an application programming interface (API). The new HFM helps us inform the public and policymakers about significant parts of the U.S. financial system.

Short-Term Funding Monitor

The STFM was updated to include historical data on Deliver Versus Payment and General Collateral Facility repurchase agreement data to give users a more holistic view of markets.

U.S. Money Market Fund Monitor

Improvements to the MMF addressed recent changes to SEC Form N-MFP data. The improvements accommodate new data structures and revise existing data visualizations.

Data

We focused on enhancements to JADE that facilitate financial stability research, data sharing, and the use of high-performance computing and analytic tools. We published the Final Rule establishing a data collection for certain NCCBR transactions in the U.S. repo market. In addition, we advocated for and led financial data standards efforts designed to improve financial data transparency.

Joint Analysis Data Environment

We implemented several features this year that further facilitate collaborative financial stability research, data sharing, and the use of high-performance computing and analytic tools. Researchers from the FRB, OCC, FDIC, and the Council onboarded and began their Council-approved financial stability research projects.

Final Rule on Non-Centrally Cleared Bilateral Repurchase Agreement Transactions

OFR's Final Rule establishing an ongoing data collection of certain NCCBR transactions in the U.S. repo market was published in the Federal Register on May 6, 2024. The Final Rule requires daily reporting to the OFR by certain brokers, dealers, and other financial companies with large exposures to NCCBR. The collection will remove a significant blind spot for financial regulators by providing high-quality data on NCCBR transactions, most recently estimated to be the largest of the four U.S. repo market segments. The data collection will support the work of the Council, its member agencies, and the OFR in identifying and monitoring risks to financial stability. Publishing the Final Rule was a major accomplishment and the culmination of several years of steadfast collaboration with member agencies, market participants, and the public. In FY 2024 alone, the team's major accomplishments included assessing public comments on the proposed rule, analyzing the implications of the SEC's new rules requiring central clearing of certain repo activity collateralized by U.S. Treasury securities, and developing operational procedures in preparation for the data reporting start date.

Data Collection Utility

We developed an in-house data collection capability to securely accept and store data collected directly from outside entities. This data collection utility will support the data collection from the NCCBR rule and potentially other future data collections.

Data Standards

Throughout the year, we played a strong leadership role in the realm of financial data standards. This included supporting the ROC and the FDTA and leading and contributing to multiple ISO and X9 standards development committees.

Regulatory Oversight Committee

The OFR continued to support the ROC as Secretariat, working with each of its subcommittees and working groups.

ISO and X9

In FY 2024, we began serving as the primary U.S. ISO TC 68 Financial Services liaison to ISO TC 307 blockchain/digital ledger technologies. The combined technical committee is jointly producing an international vocabulary standard for digital currencies that use blockchain and digital ledger technology solutions.

Financial Data Transparency Act

We continued to collaborate with covered agencies during the analysis phase of the FDTA in advance of the joint rulemaking. This included serving as co-facilitator, working with the nine covered agencies to assess the financial data standards that may be included in the joint rulemaking, and contributing to the publication of the joint proposed rule.

2. Achieve Organizational Excellence

We strive to achieve organizational excellence to continue enabling our teams to conduct and facilitate financial stability research. Throughout FY 2024, we focused on continuing organizational maturity efforts and enhancing workforce skills and capacity to best steward our mission. Below are a few highlights of our many accomplishments.

Accountability

In pursuit of organizational excellence, we focused on being accountable by leveraging our resources most effectively. Our integrated planning process helped our organization continue to have cohesive direction and priorities, and our successes in supporting small businesses and prudent budget management demonstrated our focus on accountability.

Integrated Planning

Our senior leadership began developing a new strategic plan early in the fiscal year. This began with an assessment of our current state, including an organizational maturity assessment; a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis; and an assessment of enterprise risks. The Office published a Strategic Plan 2025-2026, which we developed through an abridged strategic planning process. This Plan provides OFR with a roadmap through 2026. We expect to conduct a complete strategic planning cycle and create a longer-term strategic plan once a Senate-confirmed Director is on board.

Procurement

We expanded the diversity of our supplier base while upholding sound contracting principles.

We remained accountable for advancing the Treasury Department’s small business goals—serving as acquisition leaders in significantly exceeding Treasury small business acquisition goals in FY 2024. We proactively sought opportunities and strategic activities to increase small business participation in service of our mission and strategic priorities. In FY 2024, we contracted 83% of all procurements to small businesses, more than double the Treasury’s annual goal of 37% (**Figure P2-1**).

Figure P2-1. FY 2024 Department of Treasury Small Business Goals and OFR Performance

Small Business Category	FY 2024 Goal (percent)	OFR FY 2024 Results (percent)
Small Business	37	83
Small Disadvantaged Business	13	31
Veteran-Owned Small Business (VOSB)	5	32
Woman-Owned Small Business	5	15
HUB Zone	3	23

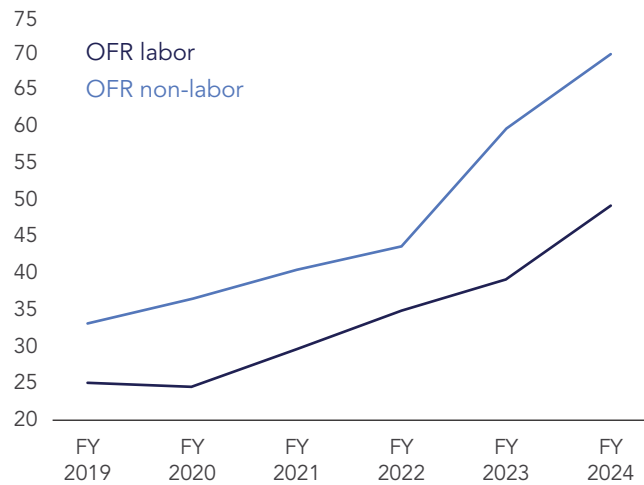
Source: Office of Financial Research

Budget

Investments to our annual budget and workforce plan cascade from our integrated planning activities. Pursuant to the Dodd-Frank Act, the Director consults with the Council Chairperson to establish our annual budget and workforce plan. We are funded through semiannual Financial Research Fund assessments.

For FY 2024, we obligated \$119.1 million, with 41% for labor and 59% for nonlabor expenses (**Figure P2-2**). This funding directly supported our strategic priorities and represents a 15% increase from the FY 2023 budget to meet the priorities of the Council, the Treasury, and the

Figure P2-2. OFR Labor Versus Non-Labor Historical Budget Comparison (\$ millions)



Note: All amounts are actual.

Source: Office of Financial Research

Administration. This increased funding enabled us to expand our in-house data collection capabilities and deliver JADE. Council member agencies can access analysis-ready data, analytic software, and high-performance computing on this platform in a secure, cloud-based environment. We expanded access to JADE and its use across Council member agencies, improved functionality, and continued to support priority financial stability research topics. Our resourcing enabled investments in cybersecurity, specifically cloud services and IT security support and software to automate workflows and tasks, cyber and financial stability-related data, shared services, and expanded partnerships.

Engagement

We also remained focused on continuing organizational maturation while enhancing our workforce’s skillset and capacity. FY 2024 was a banner year for developing, sustaining, and enabling our team to continue supporting our mission.

Workforce

We hired 52 new employees, while maintaining a low attrition rate of 7%. For the first time since 2018, the Office ended the year with nearly 85% of its workforce onboard. Our workforce grew by 29%, beginning the year with 146 employees and ending with 188 employees. Our ability to successfully attract talent from across the country enabled us to hire hard-to-find, mission-critical expertise to directly support our most transformative work. This includes enabling JADE and our data collection capacity and increasing our capability to deliver high-quality financial data, standards, research, and analysis through our broad domestic and international partnerships.

Learning and Development

We demonstrated a commitment to a culture of learning and development for our employees. This year, we leveraged the results of an OFR-specific Learning and Development Needs Assessment from FY 2023. These results helped guide our leadership in how to best use resources to support the workforce’s learning and development needs as we enhance our training program. Employees and managers worked together to establish individual development plans and advance the team’s career goals, cross-train the workforce, and expand the expertise onboard.

Collaboration

We remained committed to successful mission delivery in a hybrid work environment. To further enable strong engagement across our hybrid workforce, we updated office collaboration spaces with interactive tools and technology. We also began a pilot project using a virtual collaboration and facilitation tool.

Efficiency

We continued to mature the efficiency and service orientation of the Office. In FY 2024, we focused on our analytic technology, cybersecurity, and technology collaborations.

Analytic Enhancements

We continued to make significant technological advances by optimizing our cloud environments, enhancing analytic services, and expanding cybersecurity capabilities. We responded to increased demand for advanced analytic systems to support complex data analysis and visualization across the Treasury and the Council. We were able to seamlessly scale our cloud and analytic services to support this growing demand. Continuing our trend of developing cutting-edge technology capabilities, we rapidly and efficiently created cloud-based analytic solutions that supported complex simulations, financial modeling, and data analysis.

Cybersecurity

We engaged an independent assessor to evaluate our cybersecurity program and Zero Trust maturity. The assessment highlighted our cyber capabilities and helped enhance the security posture of our external facing services, specifically JADE and the data collection utility, furthering the safeguarding of data and instilling confidence among our stakeholders.

Collaboration

The Treasury formally recognized that our information technology program would be treated like a bureau for purposes of Treasury oversight based on our unique mission-specific technology requirements. We continue collaborating with other federal partners on

topics such as cloud and analytics, Zero Trust capabilities, and technology modernization.

APPENDIX A: ABBREVIATIONS AND ACRONYMS

AAIL	American Association of Independent Investors	Council	Financial Stability Oversight Council (see also <i>FSOC</i>)
ABS	Asset-Backed Security	CP	Commercial Paper
ACH	Automated Clearinghouse	CPMI	Committee on Payments and Market Infrastructures
AI	Artificial Intelligence	CRE	Commercial Real Estate
API	Application Programming Interface	CRFR	Climate-Related Financial Risk
BCBS	Basel Committee on Banking Supervision	CRT	Credit Risk Transfer
BDC	Business Development Company	DeFi	Decentralized Finance
BHC	Bank Holding Company	DARPA	Defense Advanced Research Projects Agency
BIS	Bank for International Settlements	DSCR	Debt Service Coverage Ratio
BNY	Bank of New York Mellon	DTCC	Depository Trust & Clearing Corporation
BSRM	Bank Systemic Risk Monitor	EBIT	Earnings before Interest and Taxes
CAPE	Cyclically Adjusted Price-to-Earnings	EBITDA	Earnings before Interest, Taxes, Depreciation, and Amortization
CBDC	Central Bank Digital Currency	EEA	Eastern Economics Association
CBOE	Chicago Board Option Exchange	EFA	Eastern Finance Association
CCAR	Comprehensive Capital Analysis and Review	ESMA	European Securities and Markets Authority
CCB	Capital Conservation Buffer	ETF	Exchange-Traded Fund
CCP	Central Counterparty	FCIC	Financial Crisis Inquiry Commission
CDO	Collateralized Debt Obligation	FDIC	Federal Deposit Insurance Corporation
CDS	Credit Default Swap	FDTA	Financial Data Transparency Act
CFPB	Consumer Financial Protection Bureau	FEMA	Federal Emergency Management Agency
CFTC	Commodity Futures Trading Commission	FFIEC	Federal Financial Institutions Examination Council
CLO	Collateralized Loan Obligation	FHFA	Federal Housing Finance Agency
CMBS	Commercial Mortgage-Backed Security	FHLB	Federal Home Loan Bank
CMDI	Corporate Bond Market Distress Index		

FICC	Fixed Income Clearing Corporation	MMMF	Money Market Mutual Fund
FIO	Federal Insurance Office	MSI	Minority Serving Institution
FMU	Financial Market Utility	NAIC	National Association of Insurance Commissioners
FRBNY	Federal Reserve Bank of New York	NAV	Net Asset Value
FSOC	Financial Stability Oversight Council (see also <i>Council</i>)	NBER	National Bureau of Economic Research
FTX	FTX Trading, Ltd.	NBFI	Nonbank Financial Institution
FY	Fiscal Year	NCCBR	Non-Centrally Cleared Bilateral Repo
G20	Group of 20	NCUA	National Credit Union Administration
GAAP	Generally Accepted Accounting Principles	NIM	Net Interest Margin
GDP	Gross Domestic Product	NRSRO	Nationally Recognized Statistical Rating Organization
GNE	Gross Notional Exposure	NSF	National Science Foundation
GSE	Government-Sponsored Enterprise	NYSE	New York Stock Exchange
G-SIB	Global Systemically Important Bank	OCC	Office of the Comptroller of the Currency
HBCU	Historically Black College and University	OFR or Office	Office of Financial Research
HFM	Hedge Fund Monitor	OTC	Over-the-Counter
HFSM	Household Financial Stress Measure	P&C	Property and Casualty
HFT	High-Frequency Trading	PDNA	Past Due and Nonaccrual
HQLA	High-Quality Liquid Assets	PoS	Proof of Stake
IAWG	Interagency Working Group on Treasury Market Surveillance	QHF	Qualifying Hedge Fund
ICBCFS	Industrial and Commercial Bank of China Financial Services	RAC	Research and Analysis Center
IOSCO	International Organization of Securities Commissions	Repo	Repurchase Agreement
ISO	International Organization for Standardization	RMBS	Residential Mortgage-Backed Securities
JADE	Joint Analysis Data Environment	ROC	Regulatory Oversight Committee
LIBOR	London Interbank Offered Rate	SBA	Small Business Administration
LTV	Loan-to-Value	SDR	Swap Data Repository
MBS	Mortgage-Backed Security	SEC	Securities and Exchange Commission
MMFM	Money Market Fund Monitor	SIP	Security Information Processor

SLHC	Savings and Loan Holding Company
SOFR	Secured Overnight Financing Rate
SPV	Special Purpose Vehicle
STFM	Short-Term Funding Monitor
SVB	Silicon Valley Bank
SWIFT	Society for Worldwide Interbank Financial Telecommunications
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TGA	Treasury General Account
TRACE	Trade Reporting and Compliance Engine
TSP	Technology Service Provider
VaR	Value-at-Risk
VOSB	Veteran-Owned Small Business
X9	Accredited Standards Committee X9 Inc.
YTD	Year to Date

APPENDIX B: GLOSSARY

Note: Not all terms in this glossary appear in this document.

Activities-Based Approach: An approach to examining risks to financial stability by focusing on financial products, activities, and practices.

Adverse Selection: When one party to a transaction has more information than the other party about some aspect of product quality or risk such that the transaction terms favor the better-informed party. See **Asymmetric Information**.

Agency Mortgage-Backed Securities: Debt securities issued by a securitization vehicle created by one of the housing finance agencies Fannie Mae, Freddie Mac, Farmer Mac, or Ginnie Mae. The vehicle uses the proceeds of securities issuance to purchase mortgages. The agencies set underwriting requirements for the loans that are purchased, and they guarantee principal and interest payments on the securities. See **Securitization Vehicle**.

Asset-Backed Securities (ABS): Debt securities issued by a securitization vehicle that invests in a pool of consumer loans, mortgages, commercial loans, royalties, or other income-generating or cash-flow-providing activity. Payments to securities holders are supported by interest and principal payments on the underlying loans or cash flows from the underlying activities. See **Securitization Vehicle**.

Asymmetric Information: Information that is known to some people but not all, resulting in one party to a transaction having better information than other parties.

Authorized Participant: A liquidity provider to an exchange-traded fund. When there is a shortage of exchange-traded fund shares in the market, the authorized participant buys the assets underlying the fund and creates more shares. When there is an excess supply of shares, the participant sells the underlying assets and redeems shares to reduce the number of shares on the market.

Bank for International Settlements (BIS): An international financial organization, headquartered in Basel, Switzerland, that serves central banks in their pursuit of monetary and financial stability, helps to foster international cooperation, and acts as a bank for central banks.

Bank Holding Company (BHC): Any company that has direct or indirect control of one or more chartered commercial banks and is regulated and supervised by the Federal Reserve under the Bank Holding Company Act of 1956. BHCs may also own nonbanking subsidiaries such as broker-dealers and asset managers.

Basel Committee on Banking Supervision (BCBS): An international forum that aims to coordinate and improve banking supervision and regulation across its 28 member countries by setting standards and encouraging dialog. As a practical matter, most countries eventually comply with the major standards it promulgates, such as those focused on capital adequacy. The Secretariat is provided

by and located within the BIS, but the BCBS is not controlled by the BIS. See **Bank for International Settlements (BIS)**.

Basel III: A comprehensive set of global regulatory standards promulgated by the BCBS to strengthen the regulation, supervision, and risk management of the banking sector. The measures include changes in standards for the regulation of bank capital, liquidity, operational risk, and related matters. See **Basel Committee on Banking Supervision (BCBS)**.

Blockchain: A decentralized digital ledger that securely stores records across a network of computers in a way that is transparent, immutable, and intended to be resistant to tampering. Each block contains data, and blocks are linked in a chronological chain. Blockchain technology has been used to record digital asset transactions and for other purposes.

Bond Duration: A measure of a bond or other debt instrument's or portfolio's market price sensitivity to interest rate changes, measured in years. Price risk rises as duration increases.

Brokered Deposit: A government-insured deposit that a bank obtains through a deposit broker. These funds may leave the bank quickly when a competitor offers a higher rate. See **Reciprocal Deposit**.

Business Development Company (BDC): Type of closed-end fund that primarily invests in small or developing companies. BDCs are often publicly traded companies and are regulated by the Securities and Exchange Commission.

Call Report: A quarterly report of a bank's financial condition and income that all federally insured U.S. depository institutions must provide to regulators.

Capital: A measure of a bank's ability to absorb losses. One measure of bank capital is the aggregate equity-to-asset ratio.

Capital Conservation Buffer (CCB): Additional capital banks are required to hold outside periods of financial stress, meant to be drawn down during times of stress. This buffer is intended to reduce the likelihood that minimum required capital ratios are breached. See **Capital** and **Capital Requirement**.

Capital Requirement: The amount of capital that a regulator requires a regulated financial institution to have as a cushion to absorb unanticipated losses and declines in asset values that could otherwise cause the institution to become insolvent or fail. The definition of "capital" varies across regulators. See **Capital**.

Central Clearing: A settlement system in which securities or derivatives of a specific type are cleared by one entity that guarantees the trades, such as a clearinghouse or central counterparty. Central clearing is an alternative to other ways of clearing, such as bilateral clearing. See **Central Counterparty**.

Central Bank Digital Currency (CBDC): A digital liability of a central bank that is widely available to the general public.

Central Counterparty (CCP): An entity that becomes the buyer to every seller and the seller to every buyer to help ensure the completion of financial trades and the performance of open contracts. CCPs provide central clearing and manage margin for the open contracts that they clear.

Charge-Off Rate: Realized loan losses as a percent of total loans. The action of charging off all or a portion of a loan that is nonperforming removes the loan from the lender's books and subtracts the loss on the

loan from the loan loss reserve. The net charge-off rate is gross charge-offs less any recoveries on written-down debt.

Circuit Breaker: A halt of trading of a security or an index for a certain period. Circuit breakers are triggered when the price of a security experiences a large percentage swing in either direction or a market index experiences a decline larger than a threshold value.

Clearing: The activity of ensuring that all the characteristics of a trade are correct and ensuring the trade complies with regulations. See **Settlement** and **Central Clearing**.

Clearing Bank: A commercial bank that facilitates the clearing and settlement of financial transactions, such as check clearing or the clearing of trades between the sellers and buyers of securities.

Clearing Member: A financial institution that is entitled to enter into a transaction with a central counterparty.

Collateral: Assets allocated to a lender by a borrower in the event of nonpayment of a debt governed by a contract between them. Some contracts permit the lender to seize and sell the collateral if the borrower is in violation of contract terms. In other contracts, such as loans to nonfinancial businesses, the collateral may give the lender a higher priority in bankruptcy court for repayment of what it is owed.

Collateralized Debt Obligation (CDO): Debt securities issued by a securitization vehicle that invests in a pool of debt instruments, typically those issued by businesses or governments. Payments to securities holders are supported by interest and principal payments on the underlying debt instruments. See **Securitization Vehicle**.

Collateralized Loan Obligation (CLO): Debt securities issued by a securitization vehicle that invests in a pool of commercial loans. Payments to securities holders are supported by interest and principal payments on the underlying debt instruments. See **Securitization Vehicle**.

Commercial Mortgage-Backed Securities (CMBS): Debt securities issued by a securitization vehicle that invests in a pool of commercial mortgages. Payments to securities holders are supported by interest and principal payments on the underlying mortgages. See **Securitization Vehicle**.

Commercial Paper (CP): Short-term (maturity of up to 270 days), unsecured corporate debt.

Committee on Payments and Market Infrastructures (CPMI): An international forum that aims to promote the safety and efficiency of payment, clearing, settlement and related arrangements by setting standards and encouraging dialog. The Secretariat is provided by, and located within, the BIS, but the CPMI is not controlled by the BIS.

Comprehensive Capital Analysis and Review (CCAR): The Federal Reserve's annual review to ensure that the largest U.S. bank holding companies have robust, forward-looking capital planning processes that account for their unique risks and sufficient capital for times of financial and economic stress. The CCAR exercise also evaluates the consistency with capital adequacy of banks' individual plans to make capital distributions such as dividend payments or stock repurchases. See **Stress Test**.

Counterparty Risk: The risk that one party to a contract, trade, or investment will default or impose losses on the other party.

Covenant-Lite Loan: A loan to a business that includes few financial covenants, which are contract terms that protect the lender if the

borrower's financial condition does not meet specified standards.

COVID-19: A highly contagious respiratory illness caused by a coronavirus and declared a pandemic in 2020 by the World Health Organization.

Credit Default Swap (CDS): A bilateral derivative contract under which the seller makes a payment to the buyer if the reference entity defaults on its debt obligations. The buyer of CDS protection makes periodic payments to the seller. The protection buyer does not need to own the debt covered by the CDS.

CDS Spread: The payment made by the buyer of credit default swap protection to the seller. The payment is typically expressed in terms similar to credit spreads on debt instruments.

Credit Rating Agency: A company that assesses the creditworthiness of a borrower or a financial instrument.

Credit Risk: The risk that a lender will suffer losses due to a borrower's default on its obligations or due to an increase in its chance of default.

Credit Risk Transfer (CRT): An arrangement that allows holders of mortgages (such as Fannie Mae, Freddie Mac, and others) to transfer mortgage credit risk to private investors through specially designed debt instruments or reinsurance arrangements.

Cybersecurity Risk: The chance of loss of the confidentiality, integrity, or availability of information technology or computer systems from the unauthorized access of those systems.

Dash to Cash: A simultaneous move by many financial market participants, businesses, and households to increase their cash balances by selling assets, including Treasuries. Associated with asset price volatility.

Debt Securitization: See **Securitization**.

Default Waterfall: The financial resources available to a central counterparty to cover losses arising from the default of one or more clearing members. The waterfall specifies the financial assets available and the order in which they will be used. See **Central Counterparty**.

Depository Institution: A financial institution, such as a bank or credit union, that has liabilities in the form of deposits.

Depository Trust & Clearing Corporation (DTCC): A regulated private holding company that owns the Depository Trust Company, National Securities Clearing Corporation, and Fixed Income Clearing Corporation. The organization provides clearing, settlement, and information services for a wide range of securities products, including government and mortgage-backed securities, corporate and municipal bonds, derivatives, mutual funds, money market instruments, alternative investment products, and insurance products.

Derivative: A financial contract the value of which is derived from the performance of underlying assets or market factors such as interest rates, currency exchange rates, or commodity, credit, and equity prices. Derivatives include structured debt obligations, swaps, futures, options, caps, floors, collars, and forwards.

Derivatives Counterparties: Parties to a derivatives transaction, either trading with each other bilaterally ("over-the-counter") or via a central counterparty.

Digital Asset: Financial assets, including what are known as cryptocurrencies, with no physical representation that are issued or transferred using blockchain cryptographic technology or distributed ledger technology. Bitcoin is the

most widely used crypto asset. See **Blockchain** and **Stablecoin**.

Discount Window: The Federal Reserve's traditional facility for making collateralized loans to depository institutions.

Distributed Ledger Technology: See **Blockchain**.

Dodd-Frank Act: Short name for the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. One of the main objectives of the Act is to promote financial stability.

Dodd-Frank Act Stress Test: The Dodd-Frank Act, as amended, requires banks with more than \$250 billion in total assets to conduct their own stress tests using scenarios provided by bank regulators. A bank must publish a summary of test results. Differs from the stress tests conducted by the Federal Reserve. See **Comprehensive Capital Analysis and Review (CCAR)**.

Duration Risk: The sensitivity of the prices of bonds and other fixed-income securities to changes in the level of interest rates.

European Securities and Markets Authority (ESMA): The European Union's securities market regulator.

Exchange-Traded Fund (ETF): An investment fund whose shares are traded on an exchange. Because ETFs are exchange-traded products, their shares are continuously priced, unlike mutual funds, which offer only end-of-day pricing. ETFs are often designed to track an index or a portfolio of assets.

Federal Financial Institutions Examination Council (FFIEC): An interagency body that prescribes uniform principles, standards, and report forms for the federal examination of financial institutions. The FFIEC makes

recommendations to promote uniformity in banking supervision.

Federal Funds: Excess reserves that financial institutions deposit at the Federal Reserve. May be traded in the federal funds market.

Federal Funds Rate: Interest rate at which depository institutions lend federal funds to each other. Also, the target interest rate for monetary policy.

Federal Home Loan Banks (FHLBs): Eleven U.S. government-sponsored banks, cooperatively owned by member financial institutions, that provide funding for member financial institutions. Funding ("advances") is collateralized by mortgages, small business, agriculture or community development loans, or government securities. The FHLBs fund themselves by issuing securities in the government agency market.

Federal Housing Finance Agency (FHFA): Agency responsible for supervision, regulation, and housing mission oversight of Fannie Mae, Freddie Mac, and the Federal Home Loan Bank System; it is also the conservator of Fannie Mae and Freddie Mac.

Federal Reserve's Emergency Lending Authority—Section 13(3): A section of the Federal Reserve Act that, with the approval of the Secretary of the Treasury, allows the Federal Reserve in "unusual and exigent circumstances" to lend to financial institutions that ordinarily do not have access to loans from the Federal Reserve.

Financial Contagion: When financial or economic shocks initially affect only a few financial markets or institutions and then spread to other parts of the financial system. The risk of contagion increases with the number and complexity of interconnections among financial markets and institutions.

Financial Market Utility (FMU): As defined by the Dodd-Frank Act, “any person that manages or operates a multilateral system for the purpose of transferring, clearing, or settling payments, securities, or other financial transactions among financial institutions or between financial institutions and the person.”

Financial Stability: The ability of the financial system to provide its basic functions for the economy, even under stress.

Financial Stability Board: An international coordinating body that monitors financial system developments on behalf of the Group of 20 (G20) nations. The FSB was established in 2009 and is the successor to the Financial Stability Forum.

Financial Stability Oversight Council (Council or FSOC): A government body created by the Dodd-Frank Act, consisting of the heads of all federal financial regulatory agencies and others, with a statutory mandate to identify risks and respond to emerging threats to financial stability. Chaired by the Secretary of the U.S. Treasury, the Council consists of 10 voting members and five non-voting members, including the OFR Director.

Fintech: Technology, especially new technology, used to enable or enhance the provision of financial services.

Fire Sale: The disorderly liquidation of assets to meet margin requirements or other urgent cash needs. Fire sales may drive prices below their fundamental value. The quantities sold are large relative to the typical volume of transactions.

Forbearance (Debt Forbearance): An agreement between borrowers and lenders, or a government mandate, to suspend debt payments temporarily without the borrower being considered in default. Also, a decision by

a lender to delay steps that would otherwise be taken to recover the amount it is owed.

Form N-MFP: A monthly disclosure of portfolio holdings submitted by money market funds to the Securities and Exchange Commission, which makes the information publicly available. SEC Rule 30b1-7 established the technical and legal details of Form N-MFP filings.

Form PF: A periodic report of portfolio holdings, leverage, and risk management practices submitted by hedge funds, private equity funds, and related entities. The report is filed with the Securities and Exchange Commission and the Commodity Futures Trading Commission, which keep the information confidential. The Dodd-Frank Act mandated the reporting to help the FSOC monitor financial stability risks.

Generally Accepted Accounting Principles (GAAP): Accounting rules published in the United States by the Financial Accounting Standards Board.

Global Systemically Important Banks (G-SIBs): Banks identified by the as having the potential to cause international financial instability. The designations are based on banks’ size, interconnectedness, complexity, dominance in certain businesses, and global scope.

Government-Sponsored Enterprise (GSE): A financial service entity created by the federal government and perceived as being implicitly guaranteed by the government. The GSEs include Fannie Mae, Freddie Mac, Sallie Mae, Farmer Mac, the Federal Home Loan Banks, the Farm Credit System, and the National Veteran Business Development Corporation.

Gross Notional Exposure (GNE): One measure of total portfolio leverage, for example in a hedge fund. GNE is calculated as

the summed absolute values of long and short notional positions, including both securities and derivatives.

Haircut: The discount at which an asset is valued when pledged as collateral. For example, a \$1 million bond with a 5% haircut would collateralize a \$950,000 loan.

Hedge Fund: A pooled investment vehicle in which accredited investors, such as wealthy individuals, banks, insurance companies, and trusts, may make investments. Hedge funds can employ a wide variety of investment and trading strategies. Many are highly leveraged. See **Qualified Hedge Fund (QHF)**.

Hedging: An investment strategy to offset the risk of portfolio or business loss in response to a change in the value of assets, liabilities, or services. An example of hedging is buying a stock and also buying a future the value of which will change in the opposite direction of the value of the stock.

High-Frequency Trading: The use of computerized securities trading algorithms to make large numbers of transactions at high speeds.

High-Quality Liquid Assets (HQLA): Assets such as central bank reserves and government securities that can be quickly and easily converted to cash even during a stress period. U.S. banking regulators require large banks to hold HQLA to comply with the Liquidity Coverage Ratio. See **Liquidity Coverage Ratio**.

High-Yield Debt: Bonds and other financial instruments rated riskier than BBB- or Baa3. Also known as speculative grade debt. Such instruments usually pay interest at higher rates than investment-grade instruments to compensate the investor for greater default risk.

Initial Margin: The amount of collateral an investor must provide when funding the purchase of securities with margin loans or when investing in derivatives. The initial margin can change after the security or derivative is purchased, but it does not change in response to a change in the value of the collateral. See **Variation Margin**.

Intraday Credit: Loans or account overdrafts that occur briefly during the course of a single day, at no charge, as long as they are repaid by the close of business that same day.

Institutional Loans: In the leveraged loan market, term loans originated by bank syndicates and sold to nonbank investors.

Interest Coverage Ratio: A measure of borrower cash flow divided by a measure of interest expense. Lower values are often associated with higher default risk.

Interest Rate Swap: A swap in which two parties exchange interest rate cash flows, with one typically making payments based on a fixed interest rate applied to a notional principal amount and the other making payments based on a floating rate. Only the net payment is exchanged. See **Swap**.

Intermediation: A financial intermediary is an entity that acts as the middleman between two parties to a financial transaction or activity. Intermediation is the activity or transaction. For example, a broker-dealer intermediates security trades, and a bank intermediates lenders and borrowers.

International Monetary Fund: An international organization that provides credit to developing nations and those in economic distress, typically conditional on economic and financial reforms.

International Organization of Securities Commissions (IOSCO): An international forum that aims to coordinate and improve securities regulation. IOSCO sets standards and encourages dialog.

Investment-Grade Debt: Bonds and other financial instruments rated BBB- or Baa3 or higher.

Legal Entity Identifier: A unique 20-digit alphanumeric code to identify each legal entity within a company that participates in financial markets.

Leverage: The use of debt or borrowed funds to invest.

Leverage Ratio: Measure of indebtedness and thus of the risk of default and loss. For banks, the leverage ratio is the Tier 1 (highest quality) equity capital of a bank divided by its total assets plus its total exposures to derivatives, securities financing transactions, and off-balance-sheet exposures. For insurance companies, the leverage ratio is assets to policyholder surplus. For hedge funds, the leverage ratio is gross asset value divided by net asset value. See **Leverage**.

Leveraged Loan: Leveraged loans are loans to companies with non-investment grade ratings (lower than BBB- or Baa3). If the borrower is not rated, loans with an interest rate spread larger than 125 basis points above a risk-free reference rate, such as the SOFR. Leveraged loans are usually senior secured instruments. See **Secured Overnight Financing Rate (SOFR)**.

Liquidity: For a market, when buyers and sellers can easily trade financial instruments in customary volumes without a material impact on price. For an entity, when the entity has sufficient cash or assets that can be sold quickly to cover its expenses.

Liquidity Coverage Ratio: The share of high-quality liquid assets that a bank holds to meet its anticipated liquidity needs. The formula for calculating the ratio is determined by regulation.

Liquidity Risk: The risk that a firm will not be able to meet its current and future cash flow and collateral needs even if it has positive net worth. See **Liquidity**.

Liquidity Transformation: The act of funding assets that are less liquid (those that are more difficult or costly to sell) with more liquid or demandable liabilities. See **Liquidity**.

Loan-to-Value Ratio: The amount of a loan as a percent of the estimated value of the asset serving as the loan's collateral.

Margin Call: A requirement that a borrower of a margin loan (or similar securities financing arrangement) increases the collateral pledged against the loan in response to reductions in the collateral's value. See **Margin Requirement**.

Margin Requirement: Rules governing the necessary collateral for a derivative, loan, or securities financing arrangement. The collateral is intended to protect the lender, in whole or in part, against the risk that the borrower will not fulfill its obligations under the contract.

Mark to Market: Accounting for the value of an asset at its current market price rather than in other ways, such as historical cost.

Market Discipline: The idea that markets can rein in risk through individual participants behaving in their own interest. For example, if risks are priced effectively and market participants are appropriately exposed to default and other risks, excessive risk-taking may be curbed. See **Moral Hazard**.

Market Making: The process in which an individual or firm stands ready to buy and sell a particular stock, security, or other asset. Market makers usually hold inventories of the securities in which they make markets. Market-making enhances investors' ability to trade and helps to keep financial markets efficient.

Market Risk: The risk that an asset's market price will change by a substantial amount.

Maturity Transformation: Funding long-term assets with short-term liabilities. A market participant engaging in this practice faces the risk that it will have to conduct a fire sale of its assets if short-term funding markets are constrained.

Metadata: Data about data. Metadata include information about the structure, format, or organization of other data.

Metadata Catalog: An organized way to present metadata for discovery, exploration, and use of the related data.

Money Market Mutual Fund (MMMF): A type of open-end mutual fund that typically invests in short-term government securities, certificates of deposit, commercial paper, or other highly liquid, low-risk securities with short remaining time to maturity. See Mutual Fund.

Moral Hazard: When people do not guard against risk because they expect someone else to pay for the losses arising from that risk.

Mortgage-Backed Security (MBS): Debt securities issued by a securitization vehicle that invests in a pool of commercial mortgages. Payments to securities holders are supported by interest and principal payments on the underlying mortgages. See **Securitization Vehicle**, **Commercial Mortgage-Backed Security (CMBS)**, and **Residential Mortgage-Backed Security (RMBS)**.

Mutual Fund: An open-end investment company, regulated by the SEC, that can invest in stocks, bonds, money market instruments, other securities, or cash, and sell its own shares to the public. Most mutual funds specialize in investing in only one or a few types of assets.

National Association of Insurance

Commissioners (NAIC): An organization that represents U.S. state insurance regulators. Through the NAIC, regulators establish accreditation standards and practices, conduct peer review, and coordinate their regulatory oversight of insurance companies.

Nationally Recognized Statistical Rating Organization (NRSRO): Credit rating agency registered with and regulated by the SEC.

Net Asset Value (NAV): The market value of an entity's assets per share. For example, a mutual fund calculates its NAV daily by dividing the fund's net value by the number of outstanding shares.

Non-Investment Grade Debt: See **High-Yield Debt**.

Notional Derivatives Exposure: The reference amount from which contractual payments will be calculated on a derivatives contract. Usually, this is not the amount at risk.

Off-Balance Sheet: Assets or entities that are not recorded on a company's balance sheet. Rather, they are disclosed only in notes to financial statements, if at all.

Off-the-Run Treasury Securities: Treasury securities outstanding in the market that were issued before the most recently issued security of similar term to maturity. Usually, they traded less frequently than on-the-run securities.

On-the-Run Treasury Securities: The most recently issued Treasury securities of each

term to maturity. These are often traded more frequently than their off-the-run predecessors.

Operational Risk: The risk of loss from events or flawed or failed processes, policies, or systems that disrupt business operations.

Option: A financial contract granting the holder the right, but not the obligation, to engage in a future transaction on an underlying security or real asset. For example, an equity call option provides the right, but not the obligation, for a fixed period to buy a block of shares at a fixed price. A put option provides the right, but not the obligation, to sell an asset for a fixed period at a fixed price.

Originate: To extend credit after processing a loan application. Banks, for example, originate mortgage loans and either hold them or sell them to other financial market participants, either by a direct sale or a securitization.

Over-the-Counter (OTC) Derivatives: Derivatives contracts negotiated privately between two parties, rather than traded on a formal securities exchange. Unlike standard exchange-traded products, OTC derivatives can be tailored to fit specific needs, such as the effect of a foreign exchange rate or commodity price over a given period.

Overnight Indexed Swap: An interest rate swap in which a fixed interest rate is swapped against an overnight reference interest rate, such as the SOFR. See **Secured Overnight Financing Rate (SOFR)**.

Pension Risk Transfer: The transfer of pension risk from a pension plan to another party, usually through insurance or annuity contracts, longevity swaps, or other contractual arrangements.

Pipeline Risk: The risk that loans being accumulated for sale cannot be sold at the expected prices or at all.

Price Discovery: The process of determining the prices of assets through the interactions of buyers and sellers in markets.

Primary Credit Rate: The interest rate the Federal Reserve charges banks for discount window borrowings.

Primary Dealer: Banks and securities broker-dealers designated by the Federal Reserve Bank of New York (FRBNY) to serve as trading counterparties when it carries out U.S. monetary policy. Among other things, primary dealers are required to participate in all auctions of U.S. government debt and to make markets for the FRBNY when it transacts on behalf of its foreign official account holders. A primary dealer buys government securities directly and can sell them to other market participants.

Primary Dealer Credit Facility: A facility for the Federal Reserve Bank of New York to make collateralized loans to primary dealers, which are the banks and securities broker-dealers designated to serve as trading counterparties in carrying out U.S. monetary policy.

Prime Broker: Companies that provide hedge funds and other investors with services such as loans, market making, or securities lending. See **Market Making**.

Qualified Hedge Fund (QHF): Hedge fund advised by a large hedge fund adviser and with a net asset value of at least \$500 million. Large hedge fund advisers are advisers that have at least \$1.5 billion in hedge fund assets under management.

Real Estate Investment Trust: Corporations that invest in income-producing real estate

and pay most of their taxable income to shareholders as dividends.

Reciprocal Deposit: A brokered bank deposit in which the broker spreads the total amount among several banks so that the investor has deposit insurance covered in excess of the \$250,000 FDIC limit. These deposits are viewed as having higher risk because they may leave the banks in which they are deposited more quickly than other deposit. See **Brokered Deposit**.

Rehypothesize: When a party that has received collateral from another party pledges the collateral to a third party. For example, repo contracts involve transfers of both cash and collateral. A dealer that receives securities in a repo transaction and uses those same securities to obtain cash in a reverse repo transaction would rehypothecate the securities.

Reinsurance: The risk management practice of insurers to transfer some of their policy risk to other insurers. A different insurer (the reinsurer), for example, could assume a portion of liability in return for a proportional amount of the premium income.

Repurchase Agreement (Repo): A transaction in which one party sells a security to another party and agrees to repurchase it at a certain date in the future at an agreed price. Market participants often issue repos on an overnight basis. A repo is similar to a collateralized loan.

Residential Mortgage-Backed Securities (RMBS): A mortgage-backed security that is collateralized by a pool of residential mortgage loans. See **Mortgage-Backed Security (MBS)**.

Resilience: Ability of the financial system or parts of the system to absorb shocks and continue to provide basic functions.

Risk Management: The business and regulatory practice of identifying and

measuring risks and developing strategies and procedures to limit them. Examples of categories of risk include credit, market, liquidity, operational, model, and regulatory.

Risk Retention: When issuers of asset-backed securities must retain at least part of the credit risk of the assets collateralizing the securities. The regulation also prohibits issuers from directly or indirectly hedging the retained credit risk.

Risk Spreads: The difference in yields of riskier assets versus assets perceived as safer, such as Treasuries and bank deposits.

Risk-Based Capital Requirement: A regulation that specifies the minimum amount of capital that a financial institution must hold to protect against losses based on the risk weight the regulation assigns to different asset categories.

Risk-Weighted Assets: Bank assets or off-balance-sheet exposures weighted according to regulatory estimates of the risk they pose to bank solvency. This asset measure is used to determine a bank's regulatory risk-based capital requirements.

Runnable Funding: Funds that can be withdrawn from a financial institution on short notice. Uninsured bank deposits, shares of money market funds, wholesale borrowings, commercial paper, and repurchase agreements are among runnable sources of funding.

Run Risk: The risk that investors lose confidence in a market participant and respond by pulling back their funding or demanding more margin or collateral.

Search for Yield (Reach for Yield): Accepting greater risks in hopes of earning higher returns when interest rates on high-quality investments are low.

Section 13(3) Authority: See **Federal Reserve’s Emergency Lending Authority—Section 13(3)**.

Secured Overnight Financing Rate (SOFR): Interest rate benchmark based on repo rates and used to set rates on financial products. Reflects the general cost of large bank borrowing that is backed by Treasury securities as collateral and thus is a near-risk-free interest rate.

Securities Lending/Borrowing: The temporary transfer of securities from one party to another for a specified fee and time period in exchange for collateral in the form of cash or securities.

Securities Information Processors (SIPs): Established by Congress and the SEC, the SIPs link the activities of U.S. markets into a single data feed.

Securitization: A financial transaction in which assets such as mortgage loans are pooled, securities representing interests in the pool are issued, and proceeds from the underlying pooled assets are used to service and repay the securities. See **Securitization Vehicle**.

Securitization Vehicle: A legal entity that is bankruptcy remote, the purpose of which is to issue multiple tranches of liabilities and to own assets. The vehicle distributes cash flows from the assets to holders of its liabilities. All actions are specified by rules in the contracts that establish the vehicle. The vehicle has no employees; it uses service providers (such as asset managers) to conduct all its activities.

Settlement: The process of transferring ownership of securities and transferring cash in payment for the securities. Some settlement systems can include institutional arrangements for confirmation, clearing, and safekeeping of securities, as well as settlement. See **Clearing**.

Shadow Banking: Provision by nonbank financial firms of financial services often provided by banks.

Shock: An event, usually unexpected, that if sufficiently large and adverse can disrupt the functioning of vulnerable parts of the financial system.

Single-Name CDS: A credit default swap where the underlying instrument is tied to one specific issuer or entity.

Skin in the Game: When originators of loans or participants in risky activities keep at least part of the risk for themselves.

Spread: The difference in yields between one debt instrument and another. Often used to refer to the spread between an instrument posing credit risk and one with similar duration that poses no credit risk.

Stable Net Asset Value: A characteristic of some money market funds in which the value of a single share remains the same, usually \$1, even when the value of the underlying assets shifts.

Stablecoin: Variety of digital asset that is pegged to the value of another asset, often but not always by maintaining reserves largely denominated in the currency of the peg. See **Digital Asset**.

Standing Facilities: Operations to execute monetary policies of the Federal Reserve and European Central Banks.

Stress Test: An exercise that shocks asset prices by a prespecified amount, sometimes along with other financial and economic variables, to estimate the effect on financial institutions or markets. Under the Dodd-Frank Act, banking regulators run annual stress tests of the largest U.S. bank holding companies.

Supplementary Leverage Ratio: Under Basel III, the ratio of a bank's Tier 1 (high-quality) capital to its total leverage exposure, which includes all on-balance-sheet assets and many off-balance-sheet exposures.

Swap: An exchange of cash flows agreed by two parties with defined terms over a fixed period.

Swap Data Repository (SDR): A central recordkeeping facility that collects and maintains a database of swap transaction terms, conditions, and other information. In some countries, SDRs are referred to as trade repositories.

Swap Execution Facility: A trading platform market participants use to execute and trade swaps by accepting bids and offers made by other participants.

Society for Worldwide Interbank Financial Telecommunications (SWIFT): Provides messaging services and interface software between wholesale financial institutions. Often used to facilitate payments internationally. SWIFT is organized as a cooperative owned by its members.

Syndicated Loan: Loan provided under a single debt contract by a group of lenders.

Systemic Risk: Risk to systemwide financial stability.

Tail Risk: The risk of an extreme event or outcome, one with a low probability of occurring.

10-Year Forward Rate: The interest rate investors expect to receive on 10-year Treasury securities in 10 years.

Tier 1 Capital Ratio and Common Equity Tier 1 Capital Ratio: Two measures comparing a bank's capital to its risk-weighted assets to show the bank's ability to absorb unexpected

losses. Tier 1 capital includes common stock, preferred stock, and retained earnings. Common Equity Tier 1 capital excludes preferred stock.

Too Big to Fail: The belief that the biggest financial firms will always be bailed out by the government if necessary. In 1984, the Comptroller of the Currency stated that the 11 largest banks could not be allowed to fail.

Tranche: A liability of a securitization vehicle. From the French word meaning "slice."

Tri-Party Repo: A repurchase agreement in which a third party, such as a clearing bank, acts as an intermediary for the exchange of cash and collateral between two counterparties. In addition to providing operational services to participants, agents in the U.S. tri-party repo market extend intraday credit to facilitate settlement of tri-party repos.

U.S. Dollar Swap Line Arrangements: Standing facilities with the Federal Reserve that allow key central banks to exchange domestic currency for U.S. dollars to satisfy dollar liquidity demand in their own markets.

Value-at-Risk (VaR): A measure used in risk management that is an estimate of the value a portfolio at a particular percentile of the probability distribution of portfolio values. For example, the VaR over 10 days and with 99% certainty measures the most one would expect to lose over a 10-day period, 99% of the time.

Variable Annuity: A tax-deferred insurance company contract where the owner can choose investment options whose values fluctuate with the underlying securities, much like mutual funds. Variable annuities may also include guarantees of minimum payments, which may exceed the value of the investment accounts.

Variation Margin: Payment made by a counterparty to a loan or derivative arrangement if the value of the collateral or of the derivative changes (see **Initial Margin**).

VIX: Chicago Board Option Exchange (CBOE) Volatility Index, a measure of 30-day expected volatility in the U.S. stock market.

Vulnerability: In the context of a financial stability risk assessment, an underlying weakness in some part of the financial system that makes the financial system susceptible to disruption and instability if hit by a shock. See **Shock**.

Yield Curve: Graphical representation of the relationship between bond yields and their respective maturities. Generally, the curve slants up because longer-term bonds have higher yields than short-term debt securities. When that relationship does not hold, the yield curve is said to be inverted or flat.

APPENDIX C: PUBLICATIONS AND CONFERENCES

OFR Working Papers (Papers in this series are designed to disseminate findings from research that advances understanding of financial stability. The papers are in a format intended to generate discussion and critical comments. They are works in progress and subject to revision. Comments and suggestions for improvements to these papers are welcome and should be directed to the authors. Views expressed are those of the authors and do not necessarily represent official positions or policy of the OFR or the U.S. Department of the Treasury.)

- *“Are Short-selling Restrictions Effective?”* October 11, 2023
- *“Trend Inflation Under Bounded Rationality,”* December 5, 2023
- *“Crash Narratives,”* December 28, 2023
- *“Intermediation Networks and Derivative Market Liquidity: Evidence from CDS Markets,”* January 24, 2024
- *“The Value of Lending Relationships,”* March 5, 2024
- *“Bank Competition and Strategic Adaptation to Climate Change,”* June 21, 2024
- *“Do Credit Default Swaps Still Lead? The Effects of Regulation on Price Discovery,”* July 17, 2024
- *“Global Banks and Natural Disasters,”* July 23, 2024
- *“What’s at Stake? Understanding the Role of Home Equity in Flood Insurance Demand,”* July 24, 2024

Staff Discussion Papers (Papers in this series cover a broader range of themes related to financial markets, financial institutions, and financial data – topics that are the building blocks of financial stability analysis. The papers in this series are works in progress and subject to revision. Comments and suggestions for improvements to these papers are welcome and should be directed to the authors. Views expressed are those of the authors and do not necessarily represent official positions or policy of the OFR or the U.S. Department of the Treasury.)

- *“Labor Market Recoveries Across the Wealth Distribution,”* September 4, 2024

OFR Briefs (Papers in this series are designed for a broader audience than OFR working papers. These papers analyze the financial stability implications of financial and regulatory policy, and recent developments in the financial system. Comments and suggestions for improvements to these papers are welcome and should be directed to the authors. OFR publications may be quoted without additional permission. Views and opinions expressed in the OFR Brief Series are those of the authors and do not necessarily represent official positions or policy of the OFR or the U.S. Department of Treasury.)

- *“Some U.S. Banks May Remain Vulnerable to Losses in Their Securities Portfolios: Introducing Two New Forward-looking Metrics to Assess Future Risk,”* December 27, 2023

- *"The Uneven Distribution of Climate Risks and Discounts,"* February 28, 2024
- *"Liquidity Coverage Ratios of Large U.S. Banks During and After the COVID-19 Shock,"* April 2, 2024
- *"Household Liquidity Measurement: A New Approach,"* July 10, 2024
- *"Bank Health and Future Commercial Real Estate Losses,"* July 11, 2024
- *"Low Home Equity Depresses Flood Insurance Take-up,"* July 24, 2024
- *"Banks' Supplementary Leverage Ratio,"* August 2, 2024
- *"How Wealth Influences Workers' Job-Switching Behavior,"* September 4, 2024

OFR Blogs

- *"Limiting Short Selling During Periods of Individual Stock Stress Reduces Volatility and Raises Prices,"* October 11, 2023
- *"OFR, University of Auckland Researchers Create Model to Analyze Effects of Trend Inflation on Economic Stability,"* December 5, 2023
- *"Wind, Fire, Water, Hail: What Is Going on In the Property Insurance Market and Why Does It Matter?"* December 14, 2023
- *"Economic Narratives Shape How Investors Perceive Risks,"* December 28, 2023
- *"Model Shows Network Density Affects Derivative Trade Costs,"* January 24, 2024
- *"Lenders Value Borrower Relationships,"* March 6, 2024
- *"OFR Congratulates CFTC and SEC on Initiation of Reporting on UPI for OTC Derivatives,"* March 19, 2024
- *"U.S. Money Market Funds Reach \$6.4 Trillion at End of 2023,"* March 26, 2024
- *"U.S. Money Market Funds Hit Record at End of Q1 2024,"* May 23, 2024
- *"How Does Competition Affect Bank Adaptation to Climate Risks,"* June 21, 2024
- *"How Do Global Banks React to Natural Disasters?"* July 23, 2024

OFR Hosted Conferences

- **Annual Financial Stability Conference.** The OFR and the Federal Reserve Bank of Cleveland cohost an annual conference on financial stability. This year's conference focused on financial stability in times of macroeconomic uncertainty and included presentations and discussions of research by the academic, regulatory, and industry communities. It took place between November 16 and 17, 2023.
- **Annual OFR PhD Symposium.** The OFR hosts upper-year PhD candidates, allowing them to present their research on financial stability and allow them to have their work reviewed and discussed by senior economists from the OFR or other federal agencies. The symposium occurred on October 27, 2023.
- **Rising Scholars Conference.** The OFR and the Review of Corporate Finance Studies hosted the second Rising Scholars Conference, which was held on May 3, 2024. The conference highlights junior researchers' work on financial stability and informs OFR staff of new developments and findings related to financial stability.
- **Financial Market Frictions and Systemic Risks Conference.** The National Bureau of Economic Research conference, which occurred in March 2024, was supported by OFR through an interagency agreement and grant with the National Science Foundation.

Key Appearances

- October 2023: Financial Management Association Annual Meeting
- November 2023: Non-centrally Cleared Bilateral Repo Market Panel 2023 U.S. Treasury Market Conference
- November 2023: UNC-Chapel Hill Finance PhD Alumni Conference
- November 2023: Federal Reserve Bank of New York's U.S. Treasury Market Conference
- December 2023: 18th Annual Conference on Asia-Pacific Financial Markets
- January 2024: Hedge Fund Research Conference
- January 2024: Mid-year Meeting of the Financial Accounting and Reporting Section of the American Accounting Association
- February 2024: ITAM Finance Conference
- February 2024: Kogod School of Business (American University) Seminar Series
- March 2024: Search and Matching Conference at INCAE Business School
- March 2024: 22nd OFR Financial Research Advisory Committee Meeting
- March 2024: Federal Reserve Bank of Richmond Brown Bag Series
- March 2024: Midwest Finance Association
- April 2024: Federal Reserve Board's Third Annual DC Search and Matching Conference
- April 2024: OCC Research Seminar Series
- April 2024: Federal Reserve Bank of Boston
- April 2024: Lincoln Institute for Land Policy
- May 2024: ECONDAT Conference
- May 2024: SEC Conference
- May 2024: Canadian Economic Association
- May 2024: Federal Forecasters Conference
- May 2024: SFS Cavalcade Conference
- May 2024: FIRS Conference
- May 2024: American Real Estate and Urban Economics Association Annual Conference
- May 2024: Federal Reserve Bank of Philadelphia Mortgage Market Research Conference
- May 2024: Midwest Macro Conference, organized by the Federal Reserve Bank of Richmond and Virginia Commonwealth University
- June 2024: Society for Economic Dynamics
- June 2024: Society of Actuaries
- 2024 Conference on Artificial Intelligence & Financial Stability
- June 2024: Seventh Annual Short-Term Funding Markets Conference
- June 2024: Oxford University VU Macro-Finance Conference
- June 2024: International Risk Management Conference
- June 2024: SED 2024 Conference
- June 2024: Canadian Economic Association Annual Meeting
- July 2024: NBER Summer Institute
- July 2024: CEPR Summer Symposium
- August 2024: Money, Banking, Payments and Finance Conference
- August 2024: European Finance Association (EFA) Conference
- August 2024: Eastern Economic Association (EEA) Conference

APPENDIX D: ENDNOTES

- 1 This report uses data available through September 30, 2024, unless otherwise indicated.
- 2 U.S. Department of the Treasury, Board of Governors of the Federal Reserve System, Federal Reserve Bank of New York, U.S. Securities and Exchange Commission, and U.S. Commodity Futures Trading Commission, *Enhancing the Resilience of the U.S. Treasury Market: 2023 Staff Progress Report* (Washington: Interagency Working Group on Treasury Market Surveillance (IAWG), November 6, 2023), https://home.treasury.gov/system/files/136/20231106_IAWG_report.pdf.
- 3 Daniel Barth, R. Jay Kahn, and Robert Mann, "Recent Developments in Hedge Funds' Treasury Futures and Repo Positions: Is the Basis Trade 'Back'?", FEDS Notes, Board of Governors of the Federal Reserve System, August 30, 2023, <https://doi.org/10.17016/2380-7172.3355>.
- 4 Lee M. Shaiman and Bridget K. Marsh, eds., *The Handbook of Loan Syndications and Trading*, Second Edition (McGraw Hill, 2022), 452.
- 5 Data providers have different methodologies for estimating property prices. Some of those methods show a much larger decline in the value of office properties than what is depicted in the figure.
- 6 FTX Trading Ltd. et al., U.S. Bankruptcy Court, District of Delaware, Case No. 22-11068-JTD, Doc 574, Filed January 25, 2023, <https://restructuring.ra.kroll.com/FTX/Home-DocketInfo>.
- 7 Federal Deposit Insurance Corporation, "BankFind Suite: Bank Failures & Assistance Data," online content, <https://banks.data.fdic.gov/explore/failures>; and Paul Tierno, "The Role of Cryptocurrency in the Failures of Silvergate, Silicon Valley, and Signature Banks," Congressional Research Service, April 25, 2023, <https://crsreports.congress.gov/product/pdf/IN/IN12148>.
- 8 Financial Stability Oversight Council (FSOC), *Report on Digital Asset Financial Stability Risks and Regulation 2022* (Washington: FSOC, October 2022), <https://home.treasury.gov/system/files/261/FSOC-Digital-Assets-Report-2022.pdf>.
- 9 Samuel Hempel, Gregory Phelan, and Thomas Ruchti, "Does Lock-Up Lead to Stability? Implications For Runs in the Proof-of-Stake Protocol," Office of Financial Research Working Paper No. 24-08, October 31, 2024, https://www.financialresearch.gov/working-papers/files/OFRwp-24-08_does-lock-up-lead-to-stability.pdf.
- 10 Carole Gresse, "Effects of Lit and Dark Market Fragmentation on Liquidity," *Journal of Financial Markets* 35 (September 2017): 1-20, <https://www.sciencedirect.com/science/article/pii/S1386418116301690?via%3Dihub>; and James Upson and Robert A. Van Ness, "Multiple Markets, Algorithmic Trading, and Market Liquidity," *Journal of Financial Markets* 32 (January 2017): 49-68, <https://www.sciencedirect.com/science/article/pii/S1386418115300148>.
- 11 Hans Degryse, Frank de Jong, and Vincent van Kervel, "The Impact of Dark Trading and Visible Fragmentation on Market Quality," *Review of Finance* 19, no. 4 (July 2015): 1587-1622, <https://doi.org/10.1093/rof/rfu027>.
- 12 Kevin McPartland and Katie Kolchin, "Understanding Fixed Income Markets in 2023," Greenwich Associates & SIFMA Insights, May 9, 2023, <https://www.sifma.org/resources/research/understanding-fixed-income-markets-in-2023/>.
- 13 Alex Harris, "ICBC Hack Kept Repo Market Open, Fueled Bond Delivery Failures," Bloomberg News, November 10, 2023, <https://www.bloomberg.com/news/articles/2023-11-10/icbc-hack-kept-repo-market-open-fueled-bond-delivery-failures?sref=UaY5GSBd>; and Eric Wallerstein, Rebecca Feng, and David Uberti, "Hack at ICBC Targeted the Digital Underbelly of Financial Markets," *The Wall Street Journal*, November 10, 2023, <https://www.wsj.com/finance/hackers-hit-u-s-arm-of-chinese-bank-e37768e6>.
- 14 Joshua Walker, "LCH Suffered Nearly 13 Hours of Op Failures in Q1," *Risk.net*, June 12, 2024, <https://www.risk.net/risk-quantum/7959538/lch-suffered-nearly-13-hours-of-op-failures-in-q1>.
- 15 Securities and Exchange Commission, "Shortening the Securities Transaction Settlement Cycle," Final Rule, Federal Register 88, no. 43 (March 6, 2023): 13872-13954, <https://www.govinfo.gov/content/pkg/FR-2023-03-06/pdf/2023-03566.pdf>.
- 16 For equity markets, see Austin Gerig, "High-Frequency Trading Synchronizes Prices in Financial Markets," Securities and Exchange Commission Working Paper, January 2015, https://www.sec.gov/about/divisions-offices/division-economic-risk-analysis/staff-papers-analyses/21jan15_gerig_high-frequency-trading. For foreign exchange markets, see Wenqian Huang et al., "HFTs and Dealer Banks: Liquidity and Price Discovery in FX Trading," Financial Conduct Authority Occasional Paper 63, January 2023, <https://www.fca.org.uk/publications/occasional-papers/op-63-hfts-dealer-banks-liquidity-fx-trading>. For Treasury markets, see Dobroslav Dobrev and Ernst Schaumburg, "High-Frequency Cross-Market Trading in U.S. Treasury Markets," Federal Reserve Bank of New York *Liberty Street Economics*, August 19, 2015, <https://libertystreeteconomics.newyorkfed.org/2015/08/high-frequency-cross-market-trading-in-us-treasury-markets/>.

- 17 Ben S. Bernanke and Cara Lown, "The Credit Crunch," *Brookings Papers on Economic Activity* 22, no. 2 (1991): 205-248, https://www.brookings.edu/wp-content/uploads/1991/06/1991b_bpea_bernanke_low_n_friedman.pdf; Roger Lowenstein, *Origins of the Crash: The Great Bubble and Its Undoing* (Penguin Books, 2004); and The Financial Crisis Inquiry Commission (FCIC), *The Financial Crisis Inquiry Report: Final Report of the National Commission on the Causes of the Financial and Economic Crisis in the United States* (Washington: FCIC, January 2011), <https://www.govinfo.gov/content/pkg/GPO-FCIC/pdf/GPO-FCIC.pdf>.
- 18 Atif Mian and Amir Sufi, *House of Debt: How They (and You) Caused the Great Recession, and How We Can Prevent It from Happening Again* (University of Chicago Press, 2014).
- 19 Dasol Kim and Nicholas Schwartz, "Household Liquidity Measurement: A New Approach," Office of Financial Research Brief No. 24-03, July 10, 2024, <https://www.financialresearch.gov/briefs/files/Ofrbrief-24-03-household-liquidity-measurement-a-new-approach.pdf>.
- 20 Consumer Finance Protection Bureau (CFPB), *Making Ends Meet in 2023* (Washington: CFPB, December 2023), https://files.consumerfinance.gov/f/documents/cfpb_making-ends-meet-in-2023_report_2023-12.pdf.
- 21 Board of Governors of the Federal Reserve System, "The July 2024 Senior Loan Officer Opinion Survey on Bank Lending Practices," online content, August 5, 2024, <https://www.federalreserve.gov/data/documents/sloos-202407.pdf>.
- 22 Arthur Fliegelman, "Wind, Fire, Water, Hail: What Is Going on in the Property Insurance Market and Why Does It Matter?," *The OFR Blog*, Office of Financial Research, December 14, 2023, <https://www.financialresearch.gov/the-ofr-blog/2023/12/14/property-insurance-market/>.
- 23 Benjamin J. Keys and Philip Mulder, "Property Insurance and Disaster Risk: New Evidence from Mortgage Escrow Data," National Bureau of Economic Research Working Paper No. 32579, June 2024, <https://www.nber.org/papers/w32579>; and Christopher Flavelle, "As Insurers Around the U.S. Bleed Cash from Climate Shocks, Homeowners Lose," *The New York Times*, May 13, 2024, <https://www.nytimes.com/interactive/2024/05/13/climate/insurance-homes-climate-change-weather.html>.
- 24 John Heilbron and Kevin Zhao, "The Uneven Distribution of Climate Risks and Discounts," Office of Financial Research Brief No. 24-01, February 28, 2024, <https://www.financialresearch.gov/briefs/files/OFRBrief-24-01-climate-risks-discounts.pdf>.
- 25 Data sources imply different levels of aggregate outstanding balances for each type of consumer credit. The true balances are not known with precision. This report uses Equifax data.
- 26 Neth Karunamuni and Dasol Kim, "A Spread-Based Measure of Household Financial Stress," Office of Financial Research Brief No. 24-06, November 13, 2024, <https://www.financialresearch.gov/briefs/files/OFRBrief-24-06-household-financial-stress.pdf>.
- 27 SecurityScorecard, "Global Third-Party Cybersecurity Breaches," 2024, <https://securityscorecard.com/wp-content/uploads/2024/02/Global-Third-Party-Cybersecurity-Breaches-Final-1.pdf>.
- 28 Arthur Fliegelman and Daniel Stemp, "The Cyberattack on Change Healthcare: Lessons for Financial Stability," Office of Financial Research Brief No. 24-05, November 13, 2024, <https://www.financialresearch.gov/briefs/files/OFRBrief-24-05-change-healthcare-cyberattack.pdf>.
- 29 American Medical Association, "Change Healthcare Cyberattack Impact," April 10, 2024, <https://www.ama-assn.org/system/files/change-healthcare-survey-results.pdf>.
- 30 UnitedHealth Group, "Information on the Change Healthcare Cyber Response," online content, September 22, 2024, <https://www.unitedhealthgroup.com/ns/changehealthcare.html>.
- 31 Joao Granja et al., "Book Value Risk Management of Banks: Limited Hedging, HTM Accounting, and Rising Interest Rates." University of Chicago Becker Friedman Institute for Economics Working Paper No. 2024-37, March 2024, https://bfi.uchicago.edu/wp-content/uploads/2024/04/BFI_WP_2024-37.pdf.
- 32 Office of the Comptroller of the Currency, Federal Reserve System, and Federal Deposit Insurance Corporation, "Regulatory Capital Rule: Large Banking Organizations and Banking Organizations With Significant Trading Activity," Federal Register 88, no. 179 (September 18, 2023): 64028-64343, <https://www.govinfo.gov/content/pkg/FR-2023-09-18/pdf/2023-19200.pdf>.
- 33 Throughout the remainder of the discussion of bank vulnerabilities, some uses of the term "banks" will reference all FDIC-insured financial institutions, which include commercial banks, thrifts, and savings banks. Banks are the vast majority of insured financial institutions by number and by assets.
- 34 Federal Deposit Insurance Corporation, "Request for Information on Deposits," Federal Register 89, no. 151 (August 6, 2024): 63946-63953, <https://www.govinfo.gov/content/pkg/FR-2024-08-06/pdf/2024-17298.pdf>.
- 35 Federal Deposit Insurance Corporation, "Advisory: Managing Commercial Real Estate Concentrations in a Challenging Economic Environment," Financial Institutions Letter FIL-64-2023, December 18, 2023, <https://www.fdic.gov/news/financial-institution-letters/2023/fil23064.html>.

- 36 Dasol Kim, Luke M. Olson, and Toan Phan, "Bank Competition and Strategic Adaptation to Climate Change," Office of Financial Research Working Paper No. 24-03, June 21, 2024, https://www.financialresearch.gov/working-papers/files/OFRwp-24-03_Bank-Competition-and-Strategic-Adaptation-to-Climate-Change.pdf.
- 37 Allen Berger et al., "Climate Risks in the U.S. Banking Sector: Evidence from Operational Losses and Extreme Storms," Federal Reserve Bank of Philadelphia Working Paper No. 23-31, November 20, 2023, <http://dx.doi.org/10.21799/frbp.wp.2023.31>.
- 38 Kristian S. Blickle, Sarah N. Hamerling, and Donald P. Morgan, "How Bad Are Weather Disasters for Banks?," Federal Reserve Bank of New York Staff Report No. 990, revised January 2022, https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr990.pdf.
- 39 Hyeyoon Jung, João A. C. Santos, and Lee Seltzer, "U.S. Banks' Exposures to Climate Transition Risks," Federal Reserve Bank of New York Staff Report No. 1058, revised January 2024, https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr1058.pdf.
- 40 Fang Cai and Sharjil Haque, "Private Credit: Characteristics and Risks," FEDS Notes, Board of Governors of the Federal Reserve System, February 23, 2024, <https://doi.org/10.17016/2380-7172.3462>.
- 41 Noele Illien and John Revill, "UBS Agrees to Pay \$388 Million over Credit Suisse's Archegos Failings," Reuters, July 24, 2023, <https://www.reuters.com/business/finance/ubs-agrees-pay-388-million-over-credit-suisse-archegos-failings-2023-07-24/>.
- 42 Financial institutions are subject to oversight of their operations and cyber defenses by their respective regulators and through different rules. One example is the Federal Reserve's rules regarding FMUs. For example, Board of Governors of the Federal Reserve System, "Financial Market Utilities," Final Rule, Federal Register 89, no. 52 (March 15, 2024): 18749-19767, <https://www.govinfo.gov/content/pkg/FR-2024-03-15/pdf/2024-05322.pdf>.
- 43 Munich Re, "Cyber Insurance Risks and Trends 2024," April 4, 2024, <https://www.munichre.com/en/insights/cyber/cyber-insurance-risks-and-trends-2024.html>.
- 44 Department of the Treasury, "Potential Federal Insurance Response to Catastrophic Cyber Incidents," Final Rule, Federal Register 87, no. 188 (September 29, 2022): 59161- 59163, <https://www.govinfo.gov/content/pkg/FR-2022-09-29/pdf/2022-21133.pdf>.
- 45 Jacob Bunge, Anupreeta Das, and Telis Demos, "Loyalty, Profit Drive Knight Rescue," *The Wall Street Journal*, August 7, 2012, <https://www.wsj.com/articles/SB10000872396390444246904577572752865497064>.
- 46 Reuters, "Exclusive: ICBC Hack Led to Unit Temporarily Owing Bank of New York Mellon \$9 Billion, Sources Say," Reuters, November 10, 2023, <https://www.reuters.com/technology/cybersecurity/icbc-hack-led-unit-temporarily-owing-bny-9-bln-sources-2023-11-10/>.
- 47 Datos Insights, "How Is ICBC in the Aftermath of a Ransomware Attack?," Datos Insights, November 27, 2023, <https://datos-insights.com/blog/datos/how-is-icbc-in-the-aftermath-of-a-ransomware-attack/>; and Paritosh Bansal, "Inside Wall Street's Scramble After ICBC Hack," Reuters, November 17, 2023, <https://www.reuters.com/technology/cybersecurity/market-inside-wall-streets-scramble-after-icbc-hack-2023-11-13/>.
- 48 Laura Matthews, "EquiLend Hack Raised Costs as Traders Flew Blind, Sources Say," Reuters, February 26, 2024, <https://www.reuters.com/technology/cybersecurity/equilend-hack-raised-costs-traders-flew-blind-sources-say-2024-02-26/>; Matt Egan, "Wall Street Firm Hit by Cyberattack That Has Knocked Systems Offline," CNN, January 24, 2024, <https://www.cnn.com/2024/01/24/business/wall-street-firm-cyberattack/index.html>; and Katherine Doherty and Donal Griffin, "Latest Cyberattack Leaves Banks Stuck with Excel and a Headache," Bloomberg News, January 24, 2024, <https://www.bloomberg.com/news/articles/2024-01-24/latest-cyberattack-leaves-banks-stuck-with-excel-and-a-headache>.
- 49 Heather Chen and Kathleen Magramo, "Finance Worker Pays Out \$25 Million After Video Call with Deepfake 'Chief Financial Officer'," February 4, 2024, <https://www.cnn.com/2024/02/04/asia/deepfake-cfo-scam-hong-kong-intl-hnk/index.html>.
- 50 LexisNexis, "7th Annual LexisNexis® True Cost of Fraud™ Study: Financial Services and Lending Report," online content, 2023, <https://risk.lexisnexis.com/insights-resources/research/us-ca-true-cost-of-fraud-study>.
- 51 PYMNTS Intelligence, "The State of Fraud and Financial Crime in the U.S. 2023," online content, September 2023, <https://www.pymnts.com/wp-content/uploads/2023/09/PYMNTS-The-State-of-Fraud-and-Financial-Crime-in-the-US-2023-September-2023.pdf>.
- 52 U.S. Department of the Treasury, *Managing Artificial Intelligence-Specific Cybersecurity Risks in the Financial Services Sector* (Washington: U.S. Department of the Treasury, March 2024), <https://home.treasury.gov/system/files/136/Managing-Artificial-Intelligence-Specific-Cybersecurity-Risks-In-The-Financial-Services-Sector.pdf>.
- 53 Samuel J. Hempel et al., "Non-Centrally Cleared Bilateral Repo," *The OFR Blog*, Office of Financial Research, August 24, 2022, <https://www.financialresearch.gov/the-ofr-blog/2022/08/24/non-centrally-cleared-bilateral-repo/>.
- 54 Samuel J. Hempel et al., "Repo Market Intermediation: Dealer Cash and Collateral Flow Management across the U.S. Repo Market," Office of Financial Research Brief No. 24-07, November 14, 2024, <https://www.financialresearch.gov/briefs/files/OFRBrief-24-07-repo-market-intermediation.pdf>.
- 55 Samuel Hempel et al., "Why Is So Much Repo Not Centrally Cleared?," Office of Financial Research Brief No. 23-01, May 12, 2023,

https://www.financialresearch.gov/briefs/files/OFRBrief_23-01_Why-Is-So-Much-Repo-Not-Centrally-Cleared.pdf.

56 Basel Committee on Banking Supervision, Committee on Payments and Market Infrastructures, and Board of the International Organization of Securities Commissions, "Review of Margining Practices," September 2022, <https://www.bis.org/bcb/publ/d537.htm>.

57 Securities and Exchange Commission, "Money Market Fund Reforms; Form PF Reporting Requirements for Large Liquidity Fund Advisers; and Technical Amendments to Form N-CSR and Form N-1A," Final Rule, Federal Register 88, no. 148 (August 3, 2023): 51404-51549, <https://www.govinfo.gov/content/pkg/FR-2023-08-03/pdf/2023-15124.pdf>.

58 For Tether, see BDO, Tether Holdings Limited Independent Auditors' Report on the Consolidated Financials Figures and Reserves Report, online content, July 31, 2024, 4, https://assets.ctfassets.net/vyse88cgwfb/6h4YWqZOXbwtBaPtYgICGy/d7462f312aa15b872f8474322ba90363/ISAE_3000R_-_Opinion_on_Consolidated_Financials_Figures_30.06.2024_RC134792024BD0209.pdf. For USDC, see Deloitte, USDC Reserve Report, online content, July 30, 2024, 4, https://www.circle.com/hubfs/USDCAttestationReports/2024/2024%20USDC_Examination%20Report%20June%202024.pdf.

59 BDO, Tether Holdings Limited Independent Auditors' Report on the Consolidated Financials Figures and Reserves Report, online content, July 31, 2024, 4, https://assets.ctfassets.net/vyse88cgwfb/6h4YWqZOXbwtBaPtYgICGy/d7462f312aa15b872f8474322ba90363/ISAE_3000R_-_Opinion_on_Consolidated_Financials_Figures_30.06.2024_RC134792024BD0209.pdf.

60 Dan Ennis, "Federal Reserve Probes Disruption of ACH Payment Network," Banking Dive, December 20, 2019, <https://www.bankingdive.com/news/federal-reserve-ach-payment-network-disruption/569534/>.

61 Jeff Cox, "The Fed's System That Allows Banks to Send Money Back and Forth Went Down for Several Hours," CNBC, February 24, 2021, <https://www.cnbc.com/2021/02/24/the-feds-system-that-allows-banks-to-send-money-back-and-forth-is-down.html>.

62 Huberto M. Ennis and David A. Price, "Discount Window Lending: Policy Trade-offs and the 1985 BoNY Computer Failure," Federal Reserve Bank of Richmond Brief No. EB15-05, May 2015, https://www.richmondfed.org/-/media/RichmondFedOrg/publications/research/economic_brief/2015/pdf/eb_15-05.pdf.

63 Katy Burne, "Bank of New York Lost Ability to Process Payments for 19 Hours," *The Wall Street Journal*, December 7, 2016, <https://www.wsj.com/articles/bny-mellon-outage-caused-some-swift-payments-to-fail-this-week-1481149459>; Tim Maurer and Arthur Nelson, "The Global Cyber Threat," *Finance & Development Magazine*, March 2021, 24-27, <https://www.imf.org/en/Publications/fandd/issues/2021/03/global-cyber-threat-to-financial-systems-maurer>; and Mathew Schwartz, "Another SWIFT Hack Stole \$12 Million," BankInfoSecurity, May 20, 2016, <https://www.bankinfosecurity.com/another-swift-hack-stole-12-million-a-9121>.

64 CBR Staff Writer, "Finastra Issues Continue—But Millions in Delayed Transactions Begin to Land," Tech Monitor, March 25, 2020, <https://techmonitor.ai/technology/cybersecurity/finastra-issues-continue>; and Jordan Robertson, "Fintech Company Survived Ransomware Attack Without Paying Ransom," Bloomberg News, April 8, 2020, <https://www.bloomberg.com/news/articles/2020-04-08/how-finastra-survived-a-ransomware-attack-without-paying-ransom>.

65 Finastra, "Finastra Statement on Cyberattack," Statement, April 3, 2020, https://www.finastra.com/sites/default/files/2020-04/Finastra_customer_letter_040420_BR_FIN.pdf; Pierluigi Paganini, "UK FinTech Company Finastra Hit by a Cyber Attack," Security Affairs, March 21, 2020, <https://securityaffairs.com/100130/data-breach/finastra-hacked.html>; Brian Krebs, "Security Breach Disrupts Fintech Firm Finastra," Krebs on Security, March 20, 2020, <https://krebsonsecurity.com/2020/03/security-breach-disrupts-fintech-firm-finastra/>; and Julian Alcazar et al., "Market Structure of Core Banking Services Providers," Federal Reserve Bank of Kansas City Briefing, March 27, 2024, <https://www.kansascityfed.org/research/payments-system-research-briefings/market-structure-of-core-banking-services-providers/>.

OFR OFFICE OF
FINANCIAL
RESEARCH

FINANCIALRESEARCH.gov